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The Technical Communication Practices of Engineering and Science Students: Results of the Phase 3 Academic Surveys

Thomas E. Pinelli
NASA Langley Research Center
Hampton, Virginia

Rebecca O. Barclay
Rensselaer Polytechnic Institute
Troy, New York

Laura M. Hecht
Indiana University
Bloomington, Indiana

John M. Kennedy
Indiana University
Bloomington, Indiana

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INTRODUCTION

The growing national debate over U.S. competitiveness appears to have produced a consensus of opinion on the following points: (1) the production, transfer, and use of knowledge is of paramount importance to the process of technological innovation; (2) current "supply-side" U.S technology policy, which emphasizes the creation of knowledge, should be modified to include the transfer, absorption, and utilize of that same knowledge; (3) a mechanism that contains a "proactive" scientific and technical information (STI) component is needed for the diffusion of knowledge from government research facilities to industry; (4) engineers and scientists should be proficient in the acquisition, communication, and use of STI; and (5) engineering and science students should be trained in the acquisition, communication, and use of STI as part of their educational preparation.

Studies such as those conducted by Mailloux (1989) demonstrate that communicating information takes up as much as 80% of an engineer's time and is considered essential to successful engineering practice. Surveys of industrial firms that employ engineers and scientists indicate that employers place a high priority on engineers' ability to acquire, to communicate orally and in writing, and to use STI. These same studies show that industry respondents rate the importance of communications skills as high as or higher than their technical skills. Many industry respondents hold the opinion that newly graduated engineers and scientists lack proficiency in communications skills (Black, 1994; Morrow, 1994; Evans, et al., 1993; Katz, 1993; Strother, 1992; Garry, 1986; Devon, 1985; and Sylvester, 1980).

Because the effective communication of information is fundamental to engineering, questions arise of what communications skills should be taught to engineering students and when, how much communications instruction is necessary, and how effective that instruction is. What is missing from any discussion of communications skills instruction for engineering student is (1) a clear explanation from the professional engineering community about what constitutes "acceptable and desirable communications norms" within that community, (2) adequate and generalizable data from engineering students about the communications skills instruction they receive, (3) adequate and generalizable data from entry-level engineers about the adequacy and usefulness of the instruction they received as students, and (4) a mechanism, probably focused within academia, that solicits feedback from the workplace and a system that utilizes the feedback for answering the questions of what and how much should be taught and when, and for determining the effectiveness of instruction.

To address the second question and help provide a student perspective, we undertook a series of student surveys in the spring semester of 1993. The results of separate surveys of students at the University of Illinois-Urbana Champaign (UI-UC), Bowling Green State University (BGSU), and Texas A&M are contained in this report.[1] The questions were assembled according to the following topics: (1) the students' selection of a career in engineering or science; (2) the importance of selected communications skills to professional success,

[1]The authors thank the Council on Library Resources (CLR) and its president, Dr. W. David Penniman, for providing the funds used to analyze the data from the student surveys.

the instruction received in these skills, and the helpfulness (usefulness) of that instruction; (3) the use and importance of libraries and other information sources and products; and (4) the use of computers, selected information technologies, and electronic networks. This study contributes to our understanding of the production, transfer, and use of information by engineering and science students and provides feedback that may be helpful in shaping the communications components of engineering and science curricula in higher education.

BACKGROUND

The diffusion of knowledge, including its production, transfer, and use, is an essential part of aerospace R&D and is of paramount importance to the process of innovation within the U.S. aerospace industry. To learn more about this process, researchers at the NASA Langley Research Center, the Indiana University Center for Survey Research, Rensselaer Polytechnic Institute, and institutions in selected counties organized a research project to study knowledge diffusion in aerospace. Sponsored by NASA and the DoD, endorsed by aerospace professional societies, and sanctioned by several groups and panels, the *NASA/DoD Aerospace Knowledge Diffusion Research Project* was begun in 1989 as a five-year project "to provide descriptive and analytical data regarding the flow of scientific and technical information (STI) at the individual, organizational, national, and international levels and to examine both the channels used to communicate STI and the social system of the aerospace knowledge diffusion process" (Pinelli, Kennedy, and Barclay, 1991). The Project, in four phases, focuses on technology rather than science and on engineers rather than scientists and takes the position that STI resulting from federally funded aerospace R&D is an economic asset or resource rather than a component of national security. The Project Fact Sheet is Appendix A.

The research results of the Project could be used to understand the information environment in which U.S. aerospace engineers and scientists work (that is, the academic, government, and industrial sectors), the information-seeking behaviors of U.S. aerospace engineers and scientists, and the factors that influence their use of STI. Such an understanding could (1) lead to the development of practical theory, (2) contribute to the design and development of systems for diffusing aerospace information, and (3) have practical implications for transferring the results of federally funded R&D to the U.S. aerospace community.

METHODS

A group of engineering faculty members, librarians, and technical communicators worked with the Project team to compile the list of survey questions. The questions were pretested before distribution. The student survey is Appendix B. A student address list was used to mail surveys to UI-UC engineering and science students. At BGSU, questionnaires were distributed in classrooms to junior- and senior-level undergraduate technology students. At Texas A&M, questionnaires were distributed to students in the Department of Aerospace Engineering. Questionnaires were distributed to undergraduate students enrolled in two required engineering

courses and to graduate students via their departmental mail boxes. A single mailing was used to distribute 4723 surveys to UI-UC engineering and science students. By September 1993, a total of 1132 questionnaires were completed and returned by UI-UC students; 68 surveys were returned by students from BGSU, and 54 surveys were completed and returned by Texas A&M students. The number of surveys distributed at BGSU and Texas A&M is not known. Code books containing the aggregate responses from the UI-UC, BGSU, and Texas A&M student surveys are Appendices C, D, and E, respectively.

Data from the UI-UC student survey are presented in Section 1. The data from the BGSU and Texas A&M student surveys are presented and compared with the UI-UC data in Section 2. Because the sample size of the UI-UC data is large, we are able to make meaningful comparisons between undergraduate and graduate students when describing the educational experiences and information use of engineering and science student respondents. Chi-square tests (for categorical variables) and Student *t*-tests (for interval data) are used to estimate if observed differences between undergraduates and graduate students are statistically significant. A significant test result ($p \leq .05$) indicates that there is only a 5% probability that the observed differences between undergraduate and graduate students' distribution of responses can be attributed to chance. A significant result is therefore interpreted as evidence that students' responses on the factors or variables in question are influenced by (vary systematically with) a student's academic (undergraduate or graduate) status.

SECTION 1: PRESENTATION OF THE UI-UC STUDENT DATA

Demographic characteristics of the UI-UC respondents are summarized in Table 1. The sample includes 623 undergraduates (55%) and 509 graduate students (45%). Survey respondents are predominantly male (80.3% of undergraduates and 86.8% of graduate students). About 87% of undergraduate students are United States natives (compared to 13% foreign born), and about 88% speak English as their native language (compared to 12% who are not native speakers of English). A higher percentage of graduate students foreign born (31.8%) and speaks a native language other than English (28.5%).

Students were asked to compare their families' incomes to incomes of other families in their native country. Most students reported that their family incomes were equal to or greater than the incomes of other families, although more graduate than undergraduate students reported higher relative family incomes. Just under 82% of undergraduates reported family incomes that are equal to or greater than others, compared to 87% of graduate students.

Engineering and Science as a Career Choice

Most students made the decision to study engineering and science prior to beginning college (see table 2). Nearly 80% of the undergraduate students had made their career decisions before entering college. About 60% of the graduate students reported that they had made their

career decisions before entering college. However, this difference may not be an accurate reflection of differences between undergraduate and graduate students in the timing of the career choice. Some graduate students may have reported the time they decided to pursue a graduate degree rather than the initial point of career choice.

Table 1. Survey Demographics
[N = 1132]

Demographics	Undergraduate		Graduate	
	%	(n)	%	(n)
Gender				
Female	19.7	123	13.2	67
Male	80.3	500	86.8	442
Educational Status	55.0	623	45.0	509
Native Country				
United States	86.6	538	68.2	348
Other	13.4	83	31.8	162
Native (First) Language				
English	88.4	551	71.5	367
Other	11.6	726	28.5	146
Relative Family Income				
Higher than other families	35.7	220	42.4	216
Same as other families	45.9	283	44.6	227
Less than other families	16.4	101	12.2	62
Don't know	2.1	13	0.8	4

Table 2. Timing of the Career Decision

Timing	Undergraduate		Graduate	
	%	(n)	%	(n)
While Still In Elementary School	7.1	44	5.9	30
While In High School	70.9	442	53.8	275
When You Started College	8.2	51	16.4	84
After Starting College	11.4	71	21.9	112
Other	2.4	15	2.0	10

Factors Influencing Career Choice

Students were asked to rate the importance of six factors that may have influenced their choice of careers. Mean importance ratings are reported in table 3. For both undergraduate and graduate students, the most important factors were those related to the job itself. The perception that engineering and science offer careers with rewarding activities received the highest mean ratings from both undergraduates ($\bar{X}$ = 6.0) and graduate students ($\bar{X}$ = 6.1).

Table 3. Importance of Factors Influencing Career Choice

Factors	Undergraduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)
Your Parents Encouraged Your Area Of Study/Major	3.8	592	3.8	496
Other Family Members Encouraged Your Area Of Study/Major	3.1	556	2.9	468
Teachers Encouraged Your Area Of Study/Major	3.7	591	3.9	491
You Feel That A Career In Your Major/Area Of Study Will Lead To Financial Security	5.1	617	4.4*	508
You Feel That A Career In Your Major/Area Of Study Will Provide Rewarding Activities	6.0	623	6.1	510
Information On The Career Opportunities	4.5	596	4.1*	495

[a]Students used a 7-point scale to rate importance, where 7 indicates the highest rating.
* $p \leq 0.05$.

The expectation that engineering and science careers will lead to financial security was the second most highly rated factor for both undergraduates and graduate students. The mean importance rating on this factor was 5.1 for undergraduates. The mean score for graduate students ($\bar{X}$ = 4.4) was significantly lower than that for undergraduate ($\bar{X}$ = 5.1) students.

The availability of information on career opportunities also appears to have an important influence on the career decision. The importance of this factor was also rated significantly higher by undergraduate ($\bar{X}$ = 4.5) than graduate ($\bar{X}$ = 4.1) students. Importance ratings of the influence of other people -- parents, teachers, and other family members -- were lower than the importance rating of job-related factors. There were no significant differences in the importance ratings undergraduate and graduate students assigned to the influence of others on career choice.

Satisfaction with Career Choice

Students were asked to rate their current level of satisfaction with their career choice (table 4). Over 80% reported that they are equally happy or happier now with the choice of an engineering career than when they made the decision (83.6% of undergraduates, 80.7% of graduate students).

Table 4. Relative Happiness with Career Choice

Satisfaction Level	Undergraduate		Graduate	
	%	(n)	%	(n)
I Am Happier About My Career Choice Now Than When I First Made It	38.8	242	37.8	193
I Feel About The Same Now As When I First Made It	44.8	279	42.9	219
I Am Less Happy About My Career Choice Now	16.4	102	19.4	99

Career Expectations and Goals

This section explores the expectations of UI-UC student respondents concerning several aspects of their future careers. Students were asked to indicate the type of organization in which they hope to work after graduation. They were also given a list of 15 specific career goals and aspirations and asked to rate the importance of each to a successful career. Students were also asked about the importance of communications skills to career success.

Type of Organization. Students were asked to identify the type of organization in which they hope to work after graduation. Table 5 shows their organizational preferences. Most stu-

Table 5. Type of Organization Where Students Plan to Work After Graduation

Type of Organization	Undergraduate		Graduate	
	%[a]	(n)	%[a]	(n)
Academic	9.1	57	38.8*	199
Government	16.1	100	8.6*	44
Industry (national)	46.1	287	28.7*	147
Industry (multi-national)	36.9	230	30.0*	154
Not-for-Profit	2.6	16	1.6	8

[a]Percentages do not total 100 because students could select more than one response.
*$p \leq 0.05$.

dents report that they plan to work in industry. Over 80% of the undergraduates plan to work in either national (46.1%) or multi-national (36.9%) industrial organizations. Less than 60% of the graduate students plan to work in industry (28.7% in national and 30.0% in multi-national industries).

Almost twice as many undergraduate as graduate students plan to work in government after graduation. Over 16% of the undergraduates plan to work in government; this was the most frequent choice of undergraduates after industry. A significantly lower percentage of graduate students (8.6%) plans to work in government. The not-for-profit organization was the least popular choice of students in this study. Only 2.6% of undergraduates and 1.6% of graduate students plan to work for a not-for-profit organization.

Professional Aspirations. Students were asked to rate the importance of 15 goals to a successful career. The list includes aspirations that are classified as either engineering, science, or management goals. Table 6 shows the mean importance ratings for each goal. The majority of both undergraduate and graduate students reported that engineering goals are most important to a successful career. With one exception, the opportunity to work on complex technological problems, graduate students' ratings of engineering goals were significantly higher than the undergraduate students' ratings.

Communications Skills

The literature on engineering education establishes the importance of effective communications skills to professional success (Black, 1994; Morrow, 1994; Evans, et. al., 1993; Katz, 1993; Garry, 1986; Devon, 1985). UI-UC students were asked to assess the importance of selected communications skills to professional success, to indicate if they had received instruction in these skills, and to rate the helpfulness (usefulness) of that instruction.

Importance of Communications Skills Training

Students were asked to rate the importance of six communications skills to professional career success (table 7). Students assigned the highest importance ratings to the ability to use computer, communication and information technology ($\bar{X}$ = 6.5 for undergraduates, $\bar{X}$ = 6.4 for graduate students). Oral and written technical communications skills received the next highest importance ratings. The mean ratings for these skills were about 6.0 for undergraduate and graduate students. Significant differences in the means exist between undergraduate and graduate students for four of the six communications skills.

Having a knowledge and understanding of engineering/science information resources and materials also received a mean importance rating of about 6.0 from both groups of students. Graduate students gave significantly higher importance ratings than did undergraduate students to being able to search electronic (bibliographic) data bases and knowing how to use a library than contains engineering/science information resources and materials.

Table 6. Importance of Career Goals and Aspirations

Goals	Undergraduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)
Engineering				
Have the opportunity to explore new ideas about technology or systems	6.0	619	6.3*	510
Attain a high level staff technical position	5.0	612	4.4*	500
Have the opportunity to work on complex technological problems	5.1	612	5.1	493
Work on projects that require Learning new technological knowledge	5.3	620	5.8*	506
Work on projects that utilize the latest theoretical results	5.2	620	5.4*	512
Science				
Establish professional reputation outside of the organization	5.1	616	5.1	509
Receive patents for your ideas	5.5	621	5.8*	509
Be evaluated on the basis of your technical contributions	4.1	604	3.7*	496
Publish articles in technical journals	3.8	613	5.2*	509
Communicate your ideas to others in your profession by presenting papers at professional meetings	4.1	604	5.2*	511
Management				
Be a technical leader of a group less experienced professionals	4.8	610	5.5*	509
Plan and coordinate the work of others	5.1	619	4.6*	507
Become a manager or director	4.7	605	4.2*	503
Plan projects and make decisions affecting the organization	5.4	616	4.9*	502
Advance to a policy-making position in management	5.1	612	4.9*	500

[a]Students used a 7-point scale to rate importance, where 7 indicates the highest rating.
*$p \leq 0.05$.

Table 7. Importance of Communications Skills to Professional Success

Skills	Undergraduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)
Effectively Communicate Technical Information In Writing	5.9	623	6.4*	512
Effectively Communicate Technical Information Orally	6.0	623	6.3*	513
Have A Knowledge And Understanding Of Engineering\Science Resources And Materials	6.0	621	6.1	511
Be Able To Search Electronic (Bibliographic) Data Bases	5.3	604	5.5*	511
Know How To Use A Library That Contains Engineering\Science Resources And Materials	5.4	614	5.8*	513
Effectively Use Computer, Communication And Information Technology	6.5	623	6.4	513

[a]Students used a 7-point scale to rate importance, where 7 indicates the highest rating.
*$p \leq 0.05$.

Receipt and Helpfulness of Communications Skills Instruction

Table 8 shows the percentage of students who have received communications skills instruction. About 86% of the undergraduates and 73% of the graduate students have received instruction in the use of computer, communication, and information technology. Approximately 67% of the undergraduates and 56% of the graduates have had technical writing instruction. About half of the undergraduates but less than half of the graduate students have received instruction in speech/oral communication, using engineering/science information resources and materials, or using a library that contains engineering/science information resources and materials.

Students who had received communications skills instruction were asked to rate the helpfulness (usefulness) of that instruction (table 9). For the most part, students reported that the instruction was helpful. They assigned the highest ratings to instruction in using computer, communication, and information technology. The helpfulness ratings for instruction in the other five skills were about the same for both undergraduates and graduate students.

Table 8. Communications Skills Instruction

Skills	Undergraduate		Graduate	
	%	(n)	%	(n)
Technical Writing\Communication	66.9	413	55.5*	276
Speech/Oral Communication	50.9	314	48.2	237
Using Engineering\Science Information Resources and Materials	51.4	305	39.7*	190
Searching Electronic (Bibliographic) Data Bases	55.5	334	39.3*	188
Using a Library Containing Engineering\Science Information Resources and Materials	62.3	377	37.8*	182
Using Computer, Communication And Information Technology	86.3	530	73.3*	365

*$p \leq 0.05$.

Table 9. Helpfulness of Communications Skills Instruction[a]

Skills	Undergraduate		Graduate	
	Mean[b]	(n)	Mean[b]	(n)
Technical Writing\Communication	4.9	401	5.1	273
Speech/Oral Communication	5.0	307	5.2*	231
Using Engineering\Science Information Resources and Materials	4.8	281	5.1	174
Searching Electronic (Bibliographic) Data Bases	5.0	309	5.1	174
Using a Library Containing Engineering\Science Information Resources and Materials	5.0	357	5.1	166
Using Computer, Communication, and Information Technology	5.7	505	5.8	342

[a]Includes ratings only for those students who received training in each communication skill.
[b]Helpfulness was rated using a 7-point scale, where 7 indicates the highest rating.
*$p \leq 0.05$.

Impediments to Preparing Written Technical Communications

We asked students the extent to which a lack of knowledge/skill about certain communications principles impedes their ability to write (table 10). Overall, students did not

Table 10. Impediments to the Production of Written Technical Communications

Principles	Undergraduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)
Defining The Purpose Of The Communication	3.4	381	3.4	416
Assessing The Needs Of The Reader	3.8	383	3.7	416
Preparing/Presenting Information In An Organized Manner	3.6	397	3.5	420
Developing Paragraphs (Introductions, Transitions, Conclusions)	3.2	394	3.3	421
Writing Grammatically Correct Sentences	2.9	395	2.8	422
Notetaking And Quoting	3.1	390	3.0	406
Editing And Revising	3.3	389	3.2	400

[a]The extent to which each principle impedes was measured using a 7-point scale, where 7 indicates the highest rating.

report serious problems with their writing skills, at least to the point that any deficiencies might impede the technical writing process. Furthermore, there were no significant differences between undergraduates and graduate students in the assessments of their writing skills.

Students appear to have the least difficulty with those writing skills that most students have the opportunity to use frequently. Grammar skills, notetaking and quoting, and skills related to editing and revising received the lowest "impedance" scores (means range closely around 3.0). Skill areas where the students report the most difficulty are in assessing the needs of the reader and problems presenting information in an organized manner. The mean difficulty scores for these skill areas is just under 4.0. Areas in which students report mid-range difficulties (mean scores less than $\bar{X} = 3.5$) include defining the purpose of the communication and developing paragraphs.

Collaborative Writing

Most of the students in this study have experience in collaborative writing. Over 80% of graduate students and about two-thirds of undergraduate students report that they have produced written technical information as part of a group (table 11). Of the students who report writing collaboratively, about 50% of the graduate students write in groups, and about 38% of the undergraduate students write in groups. Table 11 also indicates the percentage of writing that is required to be collaborative. Just over 40% of writing projects assigned to undergraduates and graduate students who do some of their writing in groups is required to be collaborative.

Table 11. Percentage of Student Writing that is Collaborative

Group Writing	Undergraduate		Graduate	
	$\bar{X}^a$ %	(n)	$\bar{X}^a$ %	(n)
Writing Done in Groups	37.9	308	50.3*	381
Writing Required to be Collaborative	41.9	270	43.8	338

[a]The means exclude students who report that they never collaborate on academic writing projects.
* $p \leq 0.05$.

We also asked students who write collaboratively to compare the productivity of group writing to the productivity of writing alone. A high percentage of students feels that group writing is more productive than writing alone (table 12). Over 40% of undergraduates and nearly 45% of graduate students reported that writing in a group is more productive than writing alone. Less than one-third of all students reported that group writing is less productive, and about one-fourth reported that group writing was as productive as writing alone.

Table 12. Productivity of Collaborative Writing

Productivity of Group Writing	Undergraduate		Graduate	
	%[a]	(n)	%[a]	(n)
More Productive than Writing Alone	40.1	129	44.8	168
About the Same as Writing Alone	24.5	79	25.3	95
Less Productive Than Writing Alone	35.4	114	29.9	112

[a]Percentages exclude students who report that they never collaborate on academic writing projects.

Use and Importance of Libraries and Selected Information Sources and Products

This section examines the use and importance of libraries and STI sources and products to engineering and science students. First, we examine the type of library use instruction that student respondents received, the frequency of their library use, their reasons for not using a library, the effectiveness of the information obtained from the library in meeting students'

engineering/science information needs, and their use (search) of electronic (bibliographic) data bases. Finally, we explore the use and importance of selected information sources and products.

Library Use Instruction

We asked students to indicate whether they had received instruction in six areas related to library use (table 13). It appears that training in library use skills occurs mainly at the undergraduate level. A significantly greater percentage of undergraduates than graduate students had received training in each of the seven areas. The most common instruction received was a library tour. Nearly two-thirds of the undergraduate respondents (and about one-third of the graduate student respondents) had participated in a library tour. Over 60% of the undergraduates had also received a library presentation as part of their academic orientation, compared to 26% of the graduate students. Approximately 40% of the undergraduates had received instruction in bibliographic skills and in searching electronic data bases for bibliographic references.

Table 13. Library Instruction

Type of Instruction	Undergraduate		Graduate	
	%[a]	(n)	%[a]	(n)
Library Tour	63.9	260	33.4*	143
Library Presentation As Part Of Academic Orientation	59.6	236	26.0*	108
Library Orientation As Part Of An Engineering/ Science Course	24.6	92	11.2*	44
Library Skill/Use Course (Bibliographic Instruction)	38.4	148	15.0*	61
Library Skill/Use Course In Engineering/Science Information Resources And Materials	17.9	66	11.0*	44
Library Instruction For End-User Searching Of Electronic (Bibliographic) Data Bases	40.6	155	24.9*	103

[a]Percentages include only students who reported that the instruction was available.
*$p \leq 0.05$.

Library Use

Despite being fairly well trained in library use skills, undergraduates appear to use the library much less often than graduate students do. Table 14 reports the frequency of library use during the current school term. Nearly 38% of undergraduates indicated that they had not used the library at all, compared to less than 4% of graduate students. Overall, undergraduates averaged 4.4 trips to the library during the current school term, and graduate students averaged 13.3 trips. These averages suggest that undergraduates rely on textbooks and other classroom materials to a greater extent than graduate students do for meeting their information needs.

Table 14. Use of A Library This School Term

Visits	Undergraduate		Graduate	
	%	(n)	%	(n)
0 Times	37.7	235	3.5	18
1 - 5 Times	41.6	259	32.4	166
6 - 10 Times	11.4	71	25.0	128
11 - 25 Times	5.8	36	19.7	101
26 - 50 Times	2.6	16	11.9	61
51 Or More Times	1.0	6	7.6	39
Mean	4.4		13.3*	
Median	2.0		10.1	

*$p \leq 0.05$.

Reasons for Nonuse of a Library

We also asked students who had not used a library during the current term to indicate their reasons for non-use. The percentages of undergraduate and graduate non-users by the reason for not using a library appear in table 15. About 78% of undergraduate non-users reported that they had no information needs. Only about 27% of graduate students indicated that they had no information needs. About 60% of undergraduate non-users and 43% of graduate non-users indicated that their information needs were more easily met by sources other than the library, and about one-fifth of undergraduate and graduate students reported that they had tried the library before but had difficulty finding the information they needed.

Graduate students were significantly more likely than undergraduates to indicate that they had a personal library that satisfied their information needs (22.8%, compared to 8.8% of undergraduates). About 17% of the graduate students reported that the library was too slow in getting needed information, compared to about 11% of the undergraduates. About 4% of the undergraduates and 4% of the graduate students noted that they were discouraged from using the library, although the source or reason for the discouragement was not identified.

Table 15. Reasons Students Did Not Use A Library This School Term

Reasons	Undergraduate		Graduate	
	%	(n)	%	(n)
I Had No Information Needs	77.9	148	26.5*	22
My Information Needs Were More Easily Met Some Other Way	60.1	98	42.7*	35
Tried The Library Once Or Twice Before But I Couldn't Find The Information I Needed	20.6	34	20.5	17
The Library Is Physically Too Far Away	9.6	16	17.3	14
The Library Staff Is Not Cooperative Or Helpful	3.7	6	5.1	4
The Library Staff Does Not Understand My Information Needs	7.5	12	9.0	7
The Library Did Not Have The Information I Need	17.2	28	29.6*	24
I Have My Own Personal Library And Do Not Need Another Library	8.8	14	22.8*	18
The Library Is Too Slow In Getting The Information I Need	10.9	18	17.3	14
We Have To Pay To Use The Library	0.0	0	1.3	1
We Are Discouraged From Using The Library	3.7	6	3.8	3

*$p \leq 0.05$.

Effectiveness of Information

Students who had used the library during the current term were asked to rate the effectiveness of the information obtained in the library for meeting their engineering and science information needs (table 16). Effectiveness was measured using a 7-point scale, where 7 was very effective. The effectiveness ratings given by graduate students ($\bar{X} = 5.6$) were significantly higher than those given by undergraduates ($\bar{X} = 5.0$). Almost 60% of graduate students indicated that the information was very effective, compared to less than 37% of undergraduates.

Table 16. Effectiveness of Information Obtained From the Library in Meeting Engineering/Science Information Needs

Effectiveness	Undergraduate		Graduate	
	%	(n)	%	(n)
Very Effective	36.5	138	59.0	286
Neither Effective Nor Ineffective	55.0	208	37.3	181
Very Ineffective	8.5	32	3.7	18
Mean	5.0		5.6*	

*$p \leq 0.05$.

Searching of Electronic (Bibliographic) Data Bases

We were also interested in finding out how students search electronic (bibliographic) data bases (table 17). Students appear to be well trained in conducting these searches. About 85% of both undergraduate and graduate students reported that they do all or most of their searches themselves. Only about 5% of undergraduates and 8% of graduate students obtain help from a librarian in conducting searches of electronic bibliographic data bases. The remainder (10.2% of undergraduates and 5.9% of graduate students) do not use electronic data bases.

Table 17. How U.S. Aerospace Engineering Students Search Electronic (Bibliographic) Data Bases

Approach	Undergraduate		Graduate	
	%	(n)	%	(n)
I Do **All** Searches Myself	48.8	201	47.8	219
I Do **Most** Searches Myself	35.9	148	38.0	174
I Do **Half** By Myself And **Half** Through A Librarian	4.4	18	4.1	19
I Do **Most** Searches Through A Librarian	0.5	2	3.5	16
I Do **All** Searches Through A Librarian	0.2	1	0.7	3
I Do **Not Use** Electronic Data Bases	9.2	38	5.5	25
I Do Not Have Access To Electronic Data Bases	1.0	4	0.4	2

Student Information-Seeking Behavior

To learn students' preferences for using particular information sources, we asked students to indicate the sequence in which they consulted a range of information resources (table 18). The

Table 18. Information Sources Used in Problem Solving

Sources	Used 1st %	Used 2nd %	Used 3rd %	Used 4th %	Used 5th %	Used 6th %	Used 7th %	Did Not Use
Undergraduate								
Used Personal Store Of Technical Information	55.3	12.3	10.0	5.0	3.3	2.1	0.0	12.1
Spoke With Students	15.9	43.9	13.0	5.5	4.7	2.8	0.5	13.8
Spoke With Faculty	13.0	15.6	33.7	7.8	5.4	3.8	0.3	20.3
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	3.9	8.6	11.8	19.5	8.6	4.1	1.6	42.0
Spoke With A Librarian	1.4	2.2	4.5	3.8	3.6	1.1	3.0	80.5
Used Literature Resources Found In A Library	2.5	7.3	11.9	13.7	10.8	6.0	0.9	46.9
Searched (Or Had Someone Search For Me) An Electronic (Bibliographic) Data Base In The Library	7.1	8.9	10.0	9.8	5.7	4.1	0.7	53.6
Graduate								
Used Personal Store Of Technical Information	50.6	14.9	11.4	8.9	3.8	3.4	0.6	6.6
Spoke With Students	7.5	23.1	13.8	13.8	12.3	8.7	1.6	19.2
Spoke With Faculty	22.9	21.1	20.5	11.2	9.4	5.8	1.6	7.4
Used Literature Resources (e.g., Conference Papers, Journal Articles, Technical Reports)	10.4	23.6	23.4	20.8	8.6	3.4	1.0	8.6
Spoke With A Librarian	0.2	1.1	1.1	4.6	9.1	6.3	8.0	69.7
Used Literature Resources Found In A Library	2.7	9.0	19.0	21.0	20.0	10.0	1.6	16.7
Searched (Or Had Someone Search For Me) An Electronic (Bibliographic) Data Base In The Library	7.9	10.0	11.6	13.3	12.0	9.8	2.3	33.2

first step for most undergraduate and graduate students was to consult their personal stores of technical information. The second step for most undergraduates was speaking with other students (43.9%). Graduate students' second step of the information search process was divided between speaking with other students (23.1%) and using literature resources (23.6%). About one-third of the undergraduates spoke with faculty members as their third step in seeking information.

Graduate students were slightly more likely to use literature resources (23.4%) than to speak to faculty (20.5%) at this stage.

With the exception of using literature resources, during the first stages of the information seeking process students, undergraduate and graduate students rely on informal resources for finding information. Formal resources, including speaking with a librarian and searching electronic (bibliographic) data bases, were utilized by less than 15% of students at any given stage of the search process.

Use and Importance of Selected Information Sources

Student participants were also asked to indicate the frequency of their use of selected information sources and the importance of these sources in meeting engineering and science information needs (table 19). Students used their personal collections of information more than any other source ($\bar{X}$ = 4.1 for graduate students and $\bar{X}$ = 3.6 for undergraduates). For undergraduates, the second most frequently used source of information was other students ($\bar{X}$ = 3.2). In contrast, the second most frequently used source of information for graduate students was the library ($\bar{X}$ = 3.5). In addition to using the library, graduate students were also significantly more likely than undergraduates to consult faculty members ($\bar{X}$ = 3.2 for graduate students and $\bar{X}$ = 2.7 for undergraduates) and librarians ($\bar{X}$ = 2.0 and $\bar{X}$ = 1.6, respectively). Personal contacts in industry and in government laboratories were the sources of information utilized least often as an information source.

Students' importance ratings of these information resources reflect a pattern similar to the pattern of frequency of use. For graduate students, personal collections of information were rated most highly ($\bar{X}$ = 6.1), followed by the library ($\bar{X}$ = 5.7), faculty members ($\bar{X}$ = 5.1), other students ($\bar{X}$ = 4.6) and librarians ($\bar{X}$ = 3.2) Undergraduates also gave the highest importance ratings to their personal collections of information ($\bar{X}$ =5.3). The undergraduate pattern diverges from that of graduate students at this point. The second most important source of information for undergraduate students was consultation with other students and with faculty ($\bar{X}$ = 4.6 for both), followed by the library ($\bar{X}$ = 4.1) and personal contacts within industry ($\bar{X}$ = 2.4). Contacts in government had the lowest mean importance ratings.

Table 19. Frequency of Use and Importance of Information Sources Used During Current School Term to Meet Engineering/Science Information Needs

Sources	Use				Importance			
	Under-graduate		Graduate		Under-graduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)	Mean[b]	(n)	Mean[b]	(n)
Your Personal Collection Of Information	3.6	408	4.1*	453	5.3	410	6.1*	455
Other Students	3.2	409	3.1	450	4.6	411	4.6	454
Faculty Members	2.7	406	3.2*	451	4.6	406	5.1*	455
Library	2.5	409	3.5*	455	4.1	409	5.7*	455
Librarian	1.6	407	2.0*	451	2.4	408	3.2*	451
Your Personal Contacts Within Industry	1.7	355	1.9	409	2.8	331	2.8	398
Your Personal Contacts At U.S. Government Laboratories	1.2	316	1.6*	384	2.0	287	2.4*	362

[a]Use was measured with a 5-point scale, where 5 is "always" uses.
[b]Importance was measured with a 7-point scale, where 7 is "very" important.
* $p \leq 0.05$.

Use and Importance of Selected Information Products

Students were also asked to about the frequency of their use of a variety of information products during the most recent school term and to rate the importance of these products in satisfying their information needs (table 20). There were significant differences between undergraduate and graduate students both in the extent of their usage and the importance of the information products listed. Undergraduate students reported higher frequencies of use and higher importance ratings than did graduate students for three information products. Undergraduates used textbooks more often than any other information product. The mean usage score for undergraduate use of textbooks was $\bar{X} = 4.1$ (out of a possible score of 5.0) compared to $\bar{X} = 3.8$ for graduate student use. Undergraduates also rated the importance of textbooks ($\bar{X} = 6.0$) significantly higher than did graduate students ($\bar{X} = 5.7$). Audio-visual materials and drawings and specifications were also used more extensively and rated more highly by undergraduates than by graduate students.

Journal articles were the information product used most frequently by graduate students. Graduate students reported significantly greater frequency of use for journal articles than undergraduates reported ($\bar{X} = 4.0$, compared to $\bar{X} = 2.4$ for undergraduates). Graduate students also gave journal articles the highest importance ratings; these ratings are significantly higher than those reported by undergraduate students ($\bar{X} = 6.2$ for graduate students and $\bar{X} = 3.8$ for undergraduate students). Graduate students also reported significantly greater frequency of use of and higher ratings for conference and meeting papers, abstracts, and technical reports.

Undergraduate and graduate students reported about the same frequency and importance of use of handbooks and computer programs.

Table 20. Frequency of Use and Importance of Information Products Used During Current School Term to Meet Engineering/Science Information Needs

Products	Use				Importance			
	Under-graduate		Graduate		Under-graduate		Graduate	
	Mean[a]	(n)	Mean[a]	(n)	Mean[b]	(n)	Mean[b]	(n)
Abstracts	1.7	398	2.9*	452	2.6	392	4.4*	451
Conference/Meeting Papers	1.5	398	3.3*	455	2.3	388	5.3*	454
Journal Articles	2.4	406	4.0*	455	3.8	399	6.2*	454
Handbooks	2.5	405	2.6	450	4.0	397	4.0	451
Textbooks	4.1	409	3.8*	454	6.0	405	5.7*	452
Computer Programs And Documentation	2.9	406	3.2	452	4.6	398	4.7	453
Bibliographic, Numeric, Factual Data Bases	1.9	403	2.4*	448	3.2	396	3.7*	448
Theses/Dissertations	1.3	403	2.6*	453	2.2	396	4.2*	453
Technical Reports	2.0	403	2.8*	451	3.1	399	4.2*	451
Audio/Visual Materials	1.5	404	1.4*	449	2.4	396	2.0*	446
Foreign Language Technical Reports	1.1	401	1.3*	445	1.6	389	1.8*	442
Technical Translations	1.1	400	1.4*	446	1.8	388	2.1*	440
Patents	1.1	399	1.1	447	1.6	387	1.6	441
Industry Technical Reports	1.5	400	1.7*	450	2.5	392	2.6	443
Drawings/Specifications	1.8	399	1.6*	451	2.9	392	2.2*	442
Preprints Or Deposited Manuscripts	1.2	399	1.9*	447	1.8	388	2.6*	447
Informal Information Products (e.g., Vendor/Supply Catalogs, Company Literature, Trade Journals/Magazines)	2.1	401	2.3*	451	3.1	397	3.2	449

[a]Use was measured with a 5-point scale, where 5 is "always" uses.
[b]Importance was measured with a 7-point scale, where 7 is "very" important.
*$p \leq 0.05$.

Use of Foreign and Domestically Produced Technical Reports

Students were asked whether they use technical reports produced in the U.S. and foreign countries (table 21). A higher percentage of graduate students than undergraduates reported using technical reports from all nine countries. Both groups report the highest use of U.S. technical

reports (85.6% of undergraduates and 95.8% of graduate students). About 24% of the undergraduates and 61% of the graduate students use technical reports produced in the U.K. About 50% of the graduate students report that they use technical reports produced in Japan and about 44% use technical reports produced in Germany. Less than 20% of undergraduates use technical reports products from these countries.

Table 21. Use of Foreign and Domestically Produced Technical Reports

Country	Undergraduate		Graduate	
	%[a]	(n)	%[a]	(n)
Australia	5.1	27	19.6	90
China	2.5	13	12.7	58
France	9.5	50	35.3	163
Germany	19.2	101	43.9	206
India	2.1	11	16.6	76
Japan	16.8	89	50.1	234
Netherlands	4.0	21	23.9	109
Russia	8.3	43	26.5	120
United Kingdom	23.7	126	60.7	296
United States	85.6	507	95.8	483

[a]Percentages exclude students who indicated that they do not have access to technical reports from each given country.

Foreign Language Fluency

In exploring students' language competencies, we focused on the languages used by major international aerospace producers. Survey respondents were asked to provide information about their reading and speaking competencies in foreign languages (table 22). About 98% of the respondents read and speak English fluently. Few students reported skill in reading or speaking languages other than English. About one-quarter indicated that they read or speak French, German, and Spanish (languages for which instruction is offered at most U.S. high schools and colleges). Less than 5% reported that they read or speak Japanese or Russian. About 15% of the respondents read or speak a language that was not identified in this survey.

Table 22. Foreign Language Fluency of
UI-UC Engineering and Science Students

Language	Reading		Speaking	
	Read %	$\bar{X}$ Ability[a]	Speak %	$\bar{X}$ Ability[a]
English	98.2	4.96	98.2	4.91
French	28.2	2.14	23.9	2.05
German	22.6	2.00	20.4	2.03
Japanese	4.8	1.98	4.9	1.83
Russian	4.4	2.43	4.6	2.52
Spanish	21.1	2.37	19.2	2.30
Other	14.1	3.53	15.1	3.53

[a]A 1 to 5 point scale was used to measure ability with "1" being passably and "5" being fluently; hence, the higher the average (mean) the greater the ability of the student to read/speak the language.

Use of Computer and Information Technology and Electronic Networks

The use of computer technology to prepare written technical communications was investigated. Students were asked about their current and anticipated use of selected information technologies. Specifically, students were asked about their use of electronic networks, their use of electronic networks for specific purposes, and their use of electronic networks to exchange messages and files.

Use of Computers to Prepare Written Technical Communications

More than half of the UI-UC engineering and science students surveyed own a personal computer (see table 23). Nearly all the students we surveyed use computers when they prepare written technical communications (95.4% of undergraduates and 99.4% of graduate students). Students who do not use computer technology to prepare written technical communications gave the following reasons for "non-use": lack of knowledge/skill using a computer, lack of access to computer technology, and prefer not to use a computer.

Use of Selected Information Technologies

Students were asked about their use and nonuse of a wide range of information technologies (table 24). Specifically, they were asked to indicate if they "already use it," "don't use it but may in the future," and "don't use it and doubt if I will." Undergraduate and graduate students reported the greatest use of computer-based information technologies such as electronic publishing, electronic mail, desk top publishing, and electronic bulletin boards and data bases.

Graduate students also make extensive use of FAX/TELEX technologies. Students do not yet participate in video or computer conferencing, but a majority of students expect to use these technologies in the future. Most students do not expect to use audio tapes or motion picture tapes in the future.

Table 23. Use of a Computer to Prepare Written Technical Communications

	Undergraduate		Graduate	
Factor	%	(n)	%	(n)
Do you own a Personal Computer?				
Yes	59.2	245	54.4	249
No	40.8	169	45.6	209
Do You Use A Computer To Prepare Written Technical Communication?				
Never	4.6	28	0.6	3
Yes	95.4	278	99.4	507
Sometimes	9.9	60	2.5	13
Frequently	17.2	104	7.1	36
Always	68.3	414	89.9	458
Your Reason(s) For Not Using A Computer?				
No/Limited Computer Access	10.7	3	33.3	1
Lack Of Knowledge/Skill Using A Computer	25.0	7	33.3	1
Prefer Not To Use A Computer	10.7	3	33.3	1
Other	53.6	15	66.7	2

Use of Electronic (Computer) Networks

Nearly all the students surveyed have access to electronic (computer)networks. Three-fourths of the undergraduates and about 91% of the graduate students indicated that they personally use electronic networks (see table 25). Approximately 10% of the undergraduates and about 4% of the graduate students who use networks use them through an intermediary. Students use networks for a variety of purposes (see table 26). Nearly all students use networks for exchanging electronic mail. About two-thirds of undergraduates and graduate students use networks for logging onto bulletin boards or conferences and for information search and data retrieval.

Many of the remaining network functions are utilized more extensively by graduate students, although high percentages of undergraduates use them as well. For example, over 90% of graduate students use networks to transfer files and to search the library's catalog. This usage

is significantly higher than that of undergraduate use; however, about two-thirds of undergraduates use these services as well. Students also use networks extensively to connect to geographically distant sites, to use analysis and design software, to search bibliographic data bases, and to order documents from the library. About 20% of student respondents use computers to control laboratory instruments and tools.

Table 24. Use, Nonuse, and Potential Use of Information Technologies

	Already Use It		Don't Use It, But May In Future		Don't Use It, And Doubt If Will	
Information Technologies	%	(n)	%	(n)	%	(n)
Undergraduate						
Audio Tapes And Cassettes	15.7	65	39.5	163	44.8	185
Motion Picture Film	8.3	34	38.1	157	53.6	221
Videotape	25.4	105	63.4	262	11.1	46
Desktop/Electronic Publishing	62.6	258	33.5	138	3.9	16
Computer Cassettes/Cartridge Tapes	21.4	88	48.7	200	29.9	123
Electronic Mail	71.9	297	25.9	107	2.2	9
Electronic Bulletin Boards	48.4	199	47.7	196	3.9	16
FAX Or TELEX	32.4	134	65.4	270	2.2	9
Electronic Data Bases	50.4	208	47.0	194	2.7	11
Video Conferencing	2.4	10	83.7	345	13.8	57
Computer Conferencing	17.4	72	75.5	312	7.0	29
Micrographics And Microforms	19.0	78	64.1	263	16.8	69
Graduate						
Audio Tapes And Cassettes	6.8	31	19.9	91	73.3	335
Motion Picture Film	3.3	15	24.6	112	72.1	329
Videotape	18.0	82	53.0	241	29.0	132
Desktop/Electronic Publishing	73.3	335	23.6	108	3.1	14
Computer Cassettes/Cartridge Tapes	35.3	159	38.2	172	26.4	119
Electronic Mail	90.0	412	9.4	43	0.7	3
Electronic Bulletin Boards	55.7	254	39.0	178	5.3	24
FAX Or TELEX	67.0	306	31.7	145	1.3	6
Electronic Data Bases	63.1	287	35.8	163	1.1	5
Video Conferencing	4.0	18	71.6	326	24.4	111
Computer Conferencing	8.3	38	76.8	351	14.9	68
Micrographics And Microforms	21.0	93	46.7	207	32.3	143

Table 25. Use of Electronic (Computer) Networks

Factor	Undergraduate		Graduate	
	%	(n)	%	(n)
Yes, I Personally Use Them	75.0	466	91.2	464
Yes, I Use Them But Through An Intermediary	10.0	62	3.7	19
No	4.2	26	1.0	5
No, Because I Do Not Have Access To Electronic Networks	1.8	5	0.2	1
No, But I May Use Them In The Future	9.0	31	3.9	20

Table 26. Use of Electronic Networks for Specific Purposes

Purpose	Undergraduate		Graduate	
	%	(n)	%	(n)
Connect To Geographically Distant Sites	67.6	244	79.7*	341
Electronic Mail	93.1	339	95.8	415
Electronic Bulletin Boards Or Conferences	64.2	233	65.0	279
Electronic File Transfer	64.5	234	91.9*	395
Log Into Computers For Such Things As Computational Analysis Or To Use Design Tools	63.2	230	72.6*	312
Control Equipment Such As Laboratory Instruments Or Machine Tools	18.5	67	20.7	88
Access/Search The Library's Catalog	79.9	290	90.5*	390
Order Documents From The Library	53.3	193	70.0*	301
Search Electronic (Bibliographic) Data Bases	70.9	258	77.3*	333
Information Search And Data Retrieval	61.4	321	64.0	306
Prepare Scientific And Technical Papers With Colleagues At Geographically Distant Sites	7.2	26	31.0*	133

*$p \leq 0.05$.

Students who use networks to exchange messages or files do so with others at a variety of locations. About 92% of undergraduates and 84% of graduate students exchange messages with members of their academic classes (see table 27). Graduate students are significantly more likely to exchange messages with others outside of their academic classes and at different geographic sites, but a majority of undergraduates do so as well.

Table 27. Use of Electronic Networks to Exchange Messages or Files

Exchange With --	Undergraduate		Graduate	
	%	(n)	%	(n)
Members Of Your Academic Classes	92.1	299	84.0	361
Other People In Your Academic Community At The **SAME** Geographic Site Who Are Not In Your Academic Classes	71.3	259	83.6*	361
Other People In Your Academic Community At A **DIFFERENT** Geographic Site Who Are Not In Your Academic Classes	53.8	196	77.5*	334
People Outside Of Your Academic Community	63.4	230	82.8*	356

*$p \leq 0.05$.

FINDINGS

1. The UI-UC engineering and science students in this survey made their career decisions early. Most students had made the decision to study engineering or science while in high school and prior to beginning college. About 16% of undergraduates and about 19% of the graduate students surveyed indicated that they are less happy with their career choice now than when they selected engineering or science as a career.

2. The most important factors influencing career decisions were those factors related to the career itself. The beliefs that a career in the chosen field will (1) provide rewarding activities and (2) lead to financial security were identified as the most important factors affecting career choice.

3. The availability of information on career opportunities was also an important factor influencing career choice. The influence of family members and teachers was moderately important and secondary to the expectation of job-related rewards. These results are virtually identical to those obtained in an earlier study by Perucci and Gerstl (1969).

4. When asked to rate the importance of a range of goals and aspirations related to their career success in engineering and science, engineering students indicated overwhelmingly that the opportunity to explore new technology or systems was most important; science students indicated that the establishment of a professional reputation was most important.

5. Graduate students expect to advance their careers through activities that develop their professional reputations among colleagues outside of their organizations, while undergraduates expect to advance their careers through management and leadership activities within the organization.

6. The majority of UI-UC students surveyed expressed the opinion that a mastery of communications and information use skills is important to their professional success. Graduate students rated the importance of these skills higher than did undergraduates.

7. A majority of the students surveyed reported that they had received communications and information use skills instruction/training. Students who had received instruction/training indicated that it was helpful (useful).

8. Undergraduates were significantly more likely than graduate students to report that they had received communications and information use skills instruction/training. This difference may indicate that such instruction/training is considered part of the undergraduate curriculum.

9. Most UI-UC student respondents have experience in preparing written technical communications collaboratively. A majority of the students surveyed produce at least some of their written technical communications as part of a group. About two-thirds of the students who write collaboratively find the process about as productive or more productive than writing alone.

10. Most of the undergraduate students surveyed have participated in a library tour or presentation. A high percentage have also received instruction in searching electronic (bibliographic) data bases. Undergraduates were more likely than graduate students to have received library use instruction, although graduate students actually use the library more frequently than do undergraduate students. This difference in library use probably reflects graduate students' needs for information that is not found in textbooks and other classroom materials.

11. Those UI-UC engineering and science students surveyed make extensive use of computers. Over half of all students surveyed own a personal computer, and nearly all of them use computers for preparing written technical communications. Most of them also use electronic (computer) networks, either personally or through an intermediary. After e-mail and file transfers, the most frequently reported uses of electronic networks are for locating and retrieving information.

12. Despite having received instruction/training in the use of information resources such as libraries and electronic (bibliographic) data bases, students tend to rely on informal information resources (personal stores of information, other students, and faculty) during the course of a search for information.

13. Among undergraduates, informal sources of information are used more frequently and rated more important than formal sources of information. Graduate students also use personal stores of information more than any other source, and they value their personal collections of information more highly than other sources of information. Graduate students identified the library as the second most frequently used source of information.

14. Textbooks are the most frequently used (and the most highly valued) information product for all students, although the usage and importance ratings of textbooks are significantly higher among undergraduates than graduate students. Computer programs and documentation are also used frequently and given high importance ratings.

15. Undergraduates infrequently use information products such as journal articles and industry technical reports. It appears that most undergraduate student information needs are easily satisfied by textbooks and other classroom materials. Although graduate students also use textbooks frequently, they typically rely on information products found in libraries.

SECTION 2: A COMPARISON OF THE UI-UC, BGSU, AND TEXAS A&M STUDENT DATA

This section compares the results of UI-UC student surveys with the results of student surveys at BGSU and Texas A&M. The UI-UC sample includes students enrolled in all engineering disciplines offered at the school[2]. At Texas A&M, surveys were distributed only to students in the Department of Aerospace Engineering. The UI-UC and Texas A&M samples include both undergraduate and graduate students. Students at BGSU are technology students[3].

Table 28 presents a demographic profile of students at all three schools. Nearly all student respondents from BGSU are undergraduate students, compared to slightly over half at UI-UC and slightly less than half at Texas A&M. There were fewer female respondents from BGSU (about 13%) and Texas A&M (about 13%) than from UI-UC (about 17%). The BGSU sample includes fewer foreign born students (5.9%) and students whose native language is not English (5.9%) than either UI-UC (21.9% and 19.0%, respectively) or Texas A&M (14.8% and 13.0%, respectively). The BGSU student sample also has the lowest percentage of respondents who are not U.S. citizens.

The UI-UC student sample is the most diverse in terms of the percentages of female and foreign students. It cannot be determined, however, whether the difference in diversity among schools is an accurate reflection of actual student populations or whether it is attributable to the small sizes of the BGSU and Texas A&M samples.

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[2]UI-UC students enrolled in the following academic disciplines responded to the survey: aeronautical/astronautical, chemical, civil, electrical and computers, mechanical and industrial, nuclear engineering, physics, computer science, materials science, and general engineering.

[3]Technology concentration areas include aerospace, construction, design, electronics, and manufacturing.

Table 28. Survey Demographics

Demographics	UI-UC (n=1147)		Bowling Green (n=68)		Texas A&M (n=54)	
	%	(n)	%	(n)	%	(n)
Educational Status						
Undergraduate	54.6	623	94.1	64	46.3	25
Graduate	45.0	513	5.9	4	51.9	28
Other	0.4	5	--	--	1.9	1
Gender						
Female	16.7	190	13.2	9	13.0	7
Male	83.3	947	86.8	59	87.0	47
Native (First) Language						
English	81.0	921	94.1	64	87.0	47
Other	19.0	216	5.9	4	13.0	7
Native Country						
U.S.	78.1	888	94.1	64	85.2	46
Other	21.9	249	5.9	4	14.8	8
U.S. Citizen						
Yes	85.4	973	97.1	66	90.7	49
No	14.6	167	2.9	2	9.3	5

Engineering and Science as a Career Choice

Students at all three schools exhibit similar career-related goals and aspirations. Table 29 summarizes the importance ratings that students assigned to career-related goals. Like students at UI-UC, students at BGSU and Texas A&M give the highest importance ratings to goals associated with the engineering and technological aspects of their future careers. BGSU students give slightly lower importance ratings to science-related professional goals, and slightly higher ratings to management-related goals, compared with UI-UC and Texas A&M students' ratings of the same goals.

Communications Skills

Students at all three schools indicate that communications skills are important for career success (see table 30). Of the six communications skills rated, the use of computer, communication and information technology received the highest importance ratings. Skills in oral and

written communications and a knowledge and understanding of STI resources and materials received the next highest ratings from all three groups of respondents.

Table 29. Importance of Career Goals and Aspirations

Goals	UI-UC		Bowling Green		Texas A&M	
	Mean[a]	(n)	Mean[a]	(n)	Mean[a]	(n)
Engineering						
Have the opportunity to explore new technology or systems	6.1	1140	6.0	68	6.3	53
Attain a high level staff technical position	5.1	1116	5.2	67	4.8	53
Have the opportunityto work on complex technological problems	5.5	1137	5.5	67	5.9	53
Work on projects that require learning new technological knowledge	5.7	1141	5.6	68	5.7	53
Work on projects that utilize the latest theoretical results	5.3	1143	5.6	67	5.6 4.1	53 52
Science						
Establish professional reputation outside of the organization	5.1	1136	5.6	67	5.2	53
Receive patents for your ideas	3.9	1111	4.4	65	4.1	52
Be evaluated on the basis of your technical contributions	5.1	1130	4.9	67	5.5	54
Publish articles in technical journals	4.4	1133	3.6	68	4.6	51
Communicate your ideas to others in your profession by presenting papers at professional meetings	4.6	1126	4.0	68	4.6	52
Management						
Be a technical leader of a group of less experienced professionals	5.0	1123	5.5	68	5.3	54
Plan and coordinate the work of others	4.9	1137	5.3	68	4.8	54
Become a manager or director	4.8	1123	5.3	67	4.4	54
Plan projects and make decisions affecting the organization	5.2	1129	5.5	68	5.0	54
Advance to a policy-making position in management	4.4	1147	4.8	67	4.2	54

[a]Students used a 7-point scale to rate the importance, where 7 indicates the highest rating.

Table 30. Importance of Communications Skills to Professional Success

Skills	UI-UC		Bowling Green		Texas A&M	
	Mean[a]	(n)	Mean[a]	(n)	Mean[a]	(n)
Effectively Communicate Technical Information In Writing	6.1	1146	5.7	67	6.2	53
Effectively Communicate Technical Information Orally	6.1	1147	6.2	67	6.2	53
Have A Knowledge And Understanding Of Engineering\Science Resources And Materials	6.1	1143	6.1	66	6.0	53
Be Able To Search Electronic (Bibliographic) Data Bases	5.4	1126	5.1	66	5.2	51
Know How To Use A Library That Contains Engineering\Science Resources And Materials	5.6	1138	5.4	66	5.5	54
Effectively Use Computer, Communication And Information Technology	6.5	1147	6.3	67	6.6	54

[a]Students used a 7-point scale to rate the importance, where 7 indicates the highest rating.

More student respondents from BGSU and Texas A&M than from UI-UC have received communications skills training (see table 31). About 80% of the UI-UC respondents, about 99% of the BGSU respondents, and about 91% of the Texas A&M respondents have received training in the use of computer, communication and information technology. A majority of the students have also received training in technical writing skills, using a library that contains STI resources, and in searching electronic (bibliographic) data bases. A higher percentage of BGSU students than UI-UC or Texas A&M students reported having received training in each skill area.

Mean rating scores of the helpfulness of the training students received in these communications skills are reported in table 32. These scores include only those students who reported that they had received training in each area. Overall, the scores indicate that students feel that their training has been helpful. The highest ratings were assigned to the helpfulness of training in using computer, communication, and information technology. The mean helpfulness ratings were highest for the BGSU sample: BGSU students gave higher helpfulness ratings to their training in all seven skills areas than did UI-UC or Texas A&M students.

Table 31. Receipt of Communications Skills Training

Skills	UI-UC		Bowling Green		Texas A&M	
	%	(n)	%	(n)	%	(n)
Technical Writing\Communication	61.9	696	86.7	58	75.5	40
Speech\Oral Communication	49.7	557	85.1	67	47.2	25
Using Engineering\Science Information Resources and Materials	46.1	498	81.5	53	67.9	36
Searching Electronic (Bibliographic) Data Bases	48.1	525	84.8	56	80.8	42
Using A Library Containing Engineering\ Science Information Resources And Materials	51.2	562	69.7	46	61.5	32
Using Computer, Communication, And Information Technology	80.4	903	98.8	67	90.6	48

Table 32. Helpfulness of Communications Skills Training[a]

Skills	UI-UC		Bowling Green		Texas A&M	
	Mean[b]	(n)	Mean[b]	(n)	Mean[b]	(n)
Technical Writing\Communication	5.0	681	5.5	58	5.4	40
Speech\Oral Communication	5.1	544	5.7	57	5.2	25
Using Engineering\Science Resources and Materials	4.9	458	5.6	49	5.1	34
Searching Electronic (Bibliographic) Data Bases	5.1	486	5.6	52	5.3	41
Using A Library Containing Engineering\ Science Information Resources And Materials	5.0	526	5.5	44	5.1	31
Using Computer, Communication, And Information Technology	5.7	855	6.2	67	6.2	48

[a]Includes only ratings for those students who received training in each communications skill.
[b]Helpfulness was rated using a 7-point scale, where 7 indicated the highest rating.

Use and Importance of Libraries and Selected Information Sources and Products

Overall, a much higher percentage of BGSU students reported having received training in a variety of library use skills than UI-UC and Texas A&M students reported (see table 33). For example, about 78% of BGSU students have received in a library tour, compared to 50% of UI-UC students and about 36% of Texas A&M students. Over 53% of BGSU students had received instruction in bibliographic skills, compared to about 27% of UI-UC students and about 22% of Texas A&M students. A greater percentage of BGSU students had also received a library presentation as part of their academic orientation (49.2%) and had had a course on using engineering and science information resources and materials (29.1%). About 43% of BGSU students and about 16% of Texas A&M students had had a library presentation as part of their academic orientation, although less than 15% of BGSU students or Texas A&M students had had a course on using engineering and science information resources and materials.

Not only were a greater percentage of BGSU students than UI-UC students and Texas A&M students trained in library use skills, BGSU students reported greater use of the library than did the other respondents. The patterns of frequency with which students used the library during the current school term are shown in table 34. The mean number of visits to the library was greatest for Texas A&M students ($\bar{X}$ = 11.3), followed by BGSU students ($\bar{X}$ = 10.1) and UI-UC students ($\bar{X}$ = 8.3).

Table 33. Library Training

	UI-UC		Bowling Green		Texas A&M	
Type Of Instruction	%[a]	(n)	%[a]	(n)	%[a]	(n)
Library Tour	50.0	548	77.8	49	35.8	19
Library Presentation As Part Of Academic Orientation	43.1	457	49.2	30	16.3	8
Library Orientation As Part Of An Engineering/Science Course	17.3	175	14.5	8	6.3	3
Library Skill/Use Course (Bibliographic Instruction)	27.0	281	53.4	31	21.6	11
Library Skill/Use Course In Engineering/Science Information Resources And Materials	13.5	136	29.1	16	14.3	7
Library Instruction For End-user Searching Of Electronic (Bibliographic) Data Bases	30.9	320	43.6	24	34.6	18

[a] Percentages include only those respondents who reported that the service was available.

Table 34. Use of A Library This School Term

Visits	UI-UC		Bowling Green		Texas A&M	
	%	(n)	%	(n)	%	(n)
0 Times	23.0	254	10.3	7	13.2	7
1 - 5 Times	38.8	428	36.8	25	45.3	24
6 - 10 Times	18.3	202	26.5	18	15.1	8
11 - 25 Times	12.6	139	22.2	15	13.2	7
26 - 50 Times	7.0	77	3.0	2	11.3	6
51 Or More Times	0.4	4	1.5	1	1.9	1
Mean	8.3		10.1		11.3	
Median	4.0		8.0		5.0	

The BGSU respondents also differ from the UI-UC and Texas A&M students in their use of information sources and the perceived importance of those sources (see table 35.) For BGSU students, the library was both the most frequently used and the most important source of information.

Table 35. Frequency of Use and Importance of Information Sources Used During Current School Term to Meet Engineering/Science Information Needs

Sources	Use						Importance					
	UI-UC		Bowling Green		Texas A&M		UI-UC		Bowling Green		Texas A&M	
	Mean[a]	(n)	Mean[a]	(n)	Mean[a]	(n)	Mean[b]	(n)	Mean[b]	(n)	Mean[b]	(n)
Your Personal Collection of Information	3.8	1124	3.2	64	4.2	54	5.7	1130	4.5	66	6.1	54
Other Students	3.2	1127	2.9	67	3.5	54	4.6	1134	3.9	66	4.7	54
Faculty Members	2.9	1126	3.3	66	3.3	54	4.8	1129	4.9	66	5.1	54
Library	2.9	1131	3.6	65	2.7	54	4.7	1133	5.2	64	4.2	54
Librarian	1.8	1123	2.1	66	1.6	54	2.7	1127	3.1	64	2.1	54
Your Personal Contacts Within Industry	1.7	999	3.1	63	1.8	50	2.8	944	4.7	61	2.4	50
Your Personal Contacts at Government Laboratories	1.4	94	1.7	55	1.7	43	2.2	828	3.0	49	2.2	42

[a]Use was measured with a 5-point scale, where 5 is "always" uses.
[b]Importance was measured with a 7-point scale, where 7 is "very" important.

In contrast, the library was the third most frequently used and the third most important source of information for UI-UC students, and the fourth for Texas A&M students. Personal collections of information were the most frequently used and the most important source of information for UI-UC and Texas A&M students. Personal collections of information had the third highest use rating and the fourth highest importance rating for BGSU students.

Another point of contrast concerns the use and importance ratings of personal contacts within industry as sources of information. The mean frequency of use of contacts in industry was $\bar{X}$ = 3.1 for BGSU students, $\bar{X}$ = 1.7 for UI-UC students, and $\bar{X}$ = 1.8 for Texas A&M students (out of a maximum possible score of five). BGSU students also rated the importance of this information resource more highly than students at the other schools. The mean rating for the BGSU sample for the importance of personal contacts within industry was $\bar{X}$ = 4.7, compared to $\bar{X}$ = 2.8 for UI-UC students and only $\bar{X}$ = 2.4 for Texas A&M students.

Table 36 compares students' use and importance ratings for a variety of specific types of information products used to satisfy scientific and technical information needs. Textbooks were the most frequently use and the most highly rated information product for all three groups of students. For many other information products, including abstracts, journal articles, computer programs and documentation, data bases, and technical reports, students demonstrated little variation in terms of use or importance ratings. BGSU students used information products such as patents, drawings, and specifications, hand-books, and such informal information products as catalogs, company literature, and trade journals, more frequently than did UI-UC and Texas A&M students. BGSU students also gave higher importance ratings to these products than did UI-UC and Texas A&M students.

Use of Computer and Information Technology and Electronic Networks

Table 37 shows the percentages of students at each school who use personal computers and electronic (computer) networks. Slightly over half of all the students surveyed own a personal computer, and nearly all use personal computers "frequently" or "always" to prepare written technical communications. Almost 90% of the UI-UC students use electronic (computer) networks, either personally or through an intermediary, compared to about 54% of the BGSU students and about 82% of the Texas A&M students. Less than 2% of the UI-UC and Texas A&M students lack access to electronic (computer) networks although about 12% of the BGSU students lack access to them.

Students from the three schools use electronic (computer) networks to perform a variety of tasks (see table 38). Over 90% of the students from UI-UC and Texas A&M use networks for exchanging electronic mail; only 47% of the BGSU students use networks for exchanging electronic mail. Overall, UI-UC and Texas A&M students show similar patterns of use of electronic (computer) networks that include connecting to geographically distant sites, electronic file transfer, and accessing and searching the library's catalog. The patterns of use for BGSU students differ considerably, although a higher percentage of BGSU students (80%) than UI-UC

students (63%) and Texas A&M students (55%) use electronic (computer) networks for information search and data retrieval.

Table 36. Frequency of Use and Importance of Information Products Used During Current School Term to Meet Engineering/Science Information Needs

Products	Use						Importance					
	UI-UC		Bowling Green		Texas A&M		UI-UC		Bowling Green		Texas A&M	
	Mean[a]	(n)	Mean[a]	(n)	Mean[a]	(n)	Mean[b]	(n)	Mean[b]	(n)	Mean[b]	(n)
Abstracts	2.2	1114	2.8	65	2.1	53	3.3	1090	3.8	62	3.5	53
Conference/Meeting Papers	2.3	1114	2.1	66	2.7	54	3.6	1087	3.0	63	4.3	54
Journal Articles	3.0	1128	3.4	66	3.2	54	4.8	1103	4.7	66	4.9	54
Handbooks	2.5	1118	3.3	64	2.7	53	4.0	1103	4.8	64	4.0	53
Textbooks	4.0	1129	4.0	66	4.3	54	5.9	1120	5.7	64	6.1	54
Computer Programs And Documentation	2.9	1124	3.0	66	3.5	54	4.5	1110	4.8	64	5.0	54
Bibliographic, Numeric, Factual Data Bases	2.0	1117	2.5	66	2.2	54	3.4	1091	3.9	61	3.3	54
Theses/Dissertations	1.8	1121	1.7	65	2.2	54	3.1	1097	2.8	60	3.4	54
Technical Reports	2.2	1120	2.9	66	3.0	54	3.5	1102	4.3	64	4.4	54
Audio/Visual Materials	1.4	1119	2.5	66	1.5	54	2.2	1091	4.0	64	1.9	53
Foreign Language Technical Reports	1.2	1110	1.3	62	1.3	54	1.7	1077	2.0	62	1.7	54
Technical Translations	1.2	1108	1.4	63	1.4	54	1.9	1075	2.3	62	1.4	54
Patents	1.1	1109	1.3	63	1.1	54	1.7	1075	2.2	65	2.8	53
Industry Technical Reports	1.5	1114	2.5	64	1.8	54	2.5	1082	4.2	62	2.3	53
Drawings/Specifications	1.7	1115	3.3	63	1.8	53	2.6	1082	5.2			
Preprints Or Deposited Manuscripts	1.5	1109	2.0	64	1.4	54	2.3	1076	3.2	61	1.9	53
Informal Information Products (e.g., Vendor/Supply Catalogs, Company Literature, Trade Journals/Magazines)	2.2	1119	3.3	66	2.0	54	3.1	1097	5.1	65	2.5	54

[a]Use was measured with a 5-point scale, where 5 is "always" uses.
[b]Importance was measured with a 7-point scale, where 7 is "very" important.

Table 37. Use of a Computer to Prepare Written Technical Information

Factor	UI-UC		Bowling Green		Texas A&M	
	%	(n)	%	(n)	%	(n)
Do You Own a Personal Computer?						
Yes	52.1	596	52.9	36	57.4	31
No	47.9	547	47.1	32	42.6	23
Do You Use a Computer to Prepare Written Technical Communication?						
Never	2.8	31	0.0	0	0.0	0
Yes						
Sometimes	6.5	73	9.0	6	0.0	0
Frequently	12.4	141	26.8	18	13.0	7
Always	78.3	882	64.2	43	87.0	4
Do You Use Electronic (Computer) Networks?						
Yes, I Personally Use Them	82.4	939	26.9	18	74.1	40
Yes, I Use Them But Through An Intermediary	7.1	81	26.9	18	7.4	4
No	2.7	31	19.4	13	9.3	5
No, Because I Do Not Have Access To Electronic Networks	1.1	12	11.9	8	1.8	1
No, But I May Use Them In the Future	6.7	76	14.9	10	7.4	4

Table 38. Use of Electronic Networks for Specific Purposes

Purpose	UI-UC		Bowling Green		Texas A&M	
	%	(n)	%	(n)	%	(n)
Connect To Geographically Distant Sites	68.9	693	38.2	13	70.5	31
Electronic Mail	93.1	945	47.1	16	90.9	40
Electronic Bulletin Boards Or Conferences	61.5	621	26.5	9	43.2	19
Electronic File Transfer	74.9	757	45.5	15	88.6	39
Log Into Computers For Such Things As Computational Analysis Or To Use Design Tools	66.5	674	67.6	23	77.3	34
Control Equipment Such As Laboratory Instruments Or Machine Tools	18.5	186	44.1	15	9.1	4
Access/Search The Library's Catalog	83.9	851	82.4	23	90.9	40
Order Documents From The Library	58.9	594	38.2	13	6.8	3
Search Electronic (Bibliographic) Data Bases	70.7	715	73.5	25	63.6	28
Information Search And Data Retrieval	62.6	632	80.0	28	54.5	24
Prepare Scientific And Technical Papers With Colleagues At Geographically Distant Sites	16.9	170	23.5	8	4.5	2

FINDINGS

1. The demographic characteristics of the "average" student are similar across the three groups of survey participants (male, U.S. citizen, and native speaker of English). Roughly half of the UI-UC and Texas A&M engineering and science students are undergraduates and half are graduate students. Nearly all the BGSU respondents are undergraduate students. (BGSU students are enrolled in engineering technology programs.)

2. BGSU respondents gave higher importance ratings than did students at other schools to goals related to developing a professional reputation within the organization through attaining leadership and management positions. BGSU students' ratings of the importance of developing a professional reputation outside of the organization are lower than UI-UC and Texas A&M students'ratings.

3. Students at all three schools gave similar importance ratings to acquiring specific communications skills; however, higher percentages of BGSU students than UI-UC and Texas A&M students have received training in communications skills. BGSU students also regard their training in the use of these skills as more helpful than students at the other schools regard their training.

4. Students at BGSU and Texas A&M used the library more frequently than UI-UC students did. BGSU students reported the highest median frequency of library use of all three groups of students.

5. Overall, UI-UC and Texas A&M students used computer networks more and for a wider variety of tasks than Bowling Green students did; however a higher percentage of BGSU students used networks for information search and data retrieval than did students at UI-UC and Texas A&M.

6. BGSU students used formal information sources (i.e., libraries and librarians) more often and value them more highly than UI-UC and Texas A&M students used and value formal information sources.

7. BGSU students used information products usually found in a library (abstracts, journal articles, conference and meeting papers) and those related to industry (industry technical reports, patents, and technical translations) more often than did UI-UC and Texas A&M students. BGSU students value most information products, particularly industry-related ones, more highly than students at UI-UC and Texas A&M value them.

CONCLUDING REMARKS

There is general agreement among engineering and science professions that (1) engineers and scientists should be proficient in acquiring, communicating, and using scientific and technical information and (2) that engineering and science students should be trained in the acquisition, communication, and use of STI as part of their educational preparation. Although the results are not generalizable, the results of the Phase 3 academic surveys do provide a student perspective about the adequacy and usefulness of the instruction they received as students. A much broader study with a more rigorous and controlled research design is need to answer the questions posed in the introduction of this report. One aspect of the broader study would include a survey of recently graduated/employed engineering and scientist students to determine to relevance, adequacy, and usefulness of the instruction they received as students to their professional work.

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APPENDIX A

NASA/DoD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT

Fact Sheet

The process of producing, transferring, and using scientific and technical information (STI), which is an essential part of aerospace research and development (R&D), can be defined as *Aerospace Knowledge Diffusion.* Studies tell us that timely access to STI can increase productivity and innovation and help aerospace engineers and scientists maintain and improve their professional skills. These same studies indicate, however, that we know little about aerospace knowledge diffusion or about how aerospace engineers and scientists find and use STI. To learn more about this process, we have organized a research project to study knowledge diffusion. Sponsored by NASA and the Department of Defense (DoD), the *NASA/DoD Aerospace Knowledge Diffusion Research Project* is being conducted by researchers at the NASA Langley Research Center, the Indiana University Center for Survey Research, and Rensselaer Polytechnic Institute. This research is endorsed by several aerospace professional societies including the AIAA, RAeS, and DGLR and has been sanctioned by the AGARD and AIAA Technical Information Panels.

This 4-phase project is providing descriptive and analytical data about the flow of STI at the individual, organizational, national, and international levels. It is examining both the channels used to communicate STI and the social system of the aerospace knowledge diffusion process. Phase 1 investigates the information-seeking habits and practices of U.S. aerospace engineers and scientists, in particular their use of government-funded aerospace STI. Phase 2 examines the industry-government interface and emphasizes the role of the information intermediary in the knowledge diffusion process. Phase 3 concerns the academic-government interface and emphasizes the information intermediary-faculty-student interface. Phase 4 explores the information-seeking behaviors of non-U.S. aerospace engineers and scientists from Western European nations, India, Israel, Japan, and the former Soviet Union.

The results of this research project will help us to understand the flow of STI at the individual, organizational, national, and international levels. The findings can be used to identify and correct deficiencies; to improve access and use; to plan new aerospace STI systems: and should provide useful information to R&D managers, information managers, and others concerned with improving access to and utilization of STI. These results will contribute to increasing productivity and to improving and maintaining the professional competence of aerospace engineers and scientists. The results of our research are being shared freely with those who participate in the study.

Dr. Thomas E. Pinelli
Mail Stop 180A
NASA Langley Research Center
Hampton, VA 23681-0001
(804) 864-2491
Fax (804) 864-8311
T.E.Pinelli@larc.nasa.gov

Dr. John M. Kennedy
Center for Survey Research
Indiana University
Bloomington, IN 47405
(812) 855-2573
Fax (812) 855-2818
kennedy@isrmail.soc.indiana.edu

Rebecca O. Barclay
Dept. of Language, Lit. & Communication
Rensselaer Polytechnic Institute
Troy, NY 12180
(804) 399-5666
Fax (804) 397-4635
barclay@infi.net

APPENDIX B

An Exploratory Student Study Conducted at the University of Illinois at Urbana-Champaign

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to: (Circle number)

		Very Unimportant						Very Important	Don't Know
1	Have the opportunity to explore new ideas about technology or systems	1	2	3	4	5	6	7	8
2	Advance to a high-level staff technical position	1	2	3	4	5	6	7	8
3	Have the opportunity to work on complex technical problems	1	2	3	4	5	6	7	8
4	Work on projects that utilize the latest theoretical results in your specialty	1	2	3	4	5	6	7	8
5	Work on projects that require learning new technical knowledge	1	2	3	4	5	6	7	8
6	Establish a reputation outside your organization as an authority in your field	1	2	3	4	5	6	7	8
7	Receive patents for your ideas	1	2	3	4	5	6	7	8
8	Publish articles in technical journals	1	2	3	4	5	6	7	8
9	Communicate your ideas to others in your profession through papers delivered at professional society meetings	1	2	3	4	5	6	7	8
10	Be evaluated on the basis of your technical contributions	1	2	3	4	5	6	7	8
11	Become a manager or director in your line of work	1	2	3	4	5	6	7	8
12	Plan and coordinate the work of others	1	2	3	4	5	6	7	8
13	Advance to a policy-making position in management	1	2	3	4	5	6	7	8
14	Plan projects and make decisions affecting the organization	1	2	3	4	5	6	7	8
15	Be the technical leader of a group of less experienced professionals	1	2	3	4	5	6	7	8

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice? (Circle number)

		Very Unimportant						Very Important	Not Applicable
1	Your parents encouraged your area of study/major	1	2	3	4	5	6	7	9
2	Other family members encouraged your area of study/major	1	2	3	4	5	6	7	9
3	Teachers encouraged your area of study/major	1	2	3	4	5	6	7	9
4	You feel that a career in your major/area of study will lead to financial security . . .	1	2	3	4	5	6	7	9
5	You feel that a career in your major/area of study will provide a career with many rewarding activities	1	2	3	4	5	6	7	9
6	Information on the career opportunities available in your major/area of study . . .	1	2	3	4	5	6	7	9

7 Other important factors (Please specify) _____

3. When did you first decide on your area of study/major? (Circle number)

1 While still in elementary school
2 While in high school (or equivalent)
3 When you started college (or equivalent)
4 After starting college (or equivalent)
5 Other (Please specify) _____

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path? Would you say: (Circle ONLY one)

1 I am more happy about my career choice now than when I first made it
2 I feel about the same now as when I first made it
3 I am less happy about my career choice now than when I first made it

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will it be for you to: (Circle number)

		Very Unimportant						Very Important	Don't Know
1	Effectively communicate technical information in writing	1	2	3	4	5	6	7	8
2	Effectively communicate technical information orally	1	2	3	4	5	6	7	8
3	Have a knowledge and understanding of engineering/science information resources and materials	1	2	3	4	5	6	7	8
4	Be able to search electronic (bibliographic) data bases	1	2	3	4	5	6	7	8
5	Know how to use a library that contains engineering/science information resources and materials	1	2	3	4	5	6	7	8
6	Effectively use computer, communication, and information technology	1	2	3	4	5	6	7	8

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in: (Circle number)

		Yes	No	No Instruction Available
1	Technical writing/communication	1	2	8
2	Speech/oral communication	1	2	8
3	Using a library that contains engineering/science information resources and materials	1	2	8
4	Using engineering/science information resources and materials	1	2	8
5	Searching electronic (bibliographic) data bases	1	2	8
6	Using computer, communication, and information technology	1	2	8

7. **If you received training or instruction in any of the following, was it helpful? (Circle number)**

		Not Helpful						Very Helpful	Don't Know	Did Not Receive Training
1	Technical writing/communication . .	1	2	3	4	5	6	7	8	10
2	Speech/oral communication	1	2	3	4	5	6	7	8	10
3	Using a library that contains engineering /science information resources and materials	1	2	3	4	5	6	7	8	10
4	Using engineering/science information resources and materials	1	2	3	4	5	6	7	8	10
5	Searching electronic (bibliographic) data bases	1	2	3	4	5	6	7	8	10
6	Using computer, communication, and information technology	1	2	3	4	5	6	7	8	10

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. **What percentage of your written technical communication involves collaborative writing (i.e., writing as a member of a group)?**

   _____ **% (If 100% of your writing is done alone, go to Question 11.)**

9. **If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?**

   _____ %

10. **In general, do you find writing as part of a group more or less productive (i.e. quantity/ quality) than writing alone? (Circle number)**

    1 Less productive than writing alone
    2 About as productive as writing alone
    3 More productive than writing alone

11. **Do you use a computer to prepare written technical communication? (Circle number)**

    1 Never
    2 Sometimes
    3 Frequently
    4 Always

    } Go to Question 13.

12. If NEVER, which one of the following best explains your reasons for non-use? (Circle numbers)

1 No or limited computer access
2 Lack of knowledge/skill using a computer
3 Prefer not to use a computer
4 Other (Please specify) _____

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce (i.e., quality/quantity) written technical communication? (Circle all that apply.)

		Does not Impede						Greatly Impedes	Don't Know
1	Defining the purpose of the communication	1	2	3	4	5	6	7	8
2	Assessing the needs of the reader	1	2	3	4	5	6	7	8
3	Preparing/presenting information in an organized manner	1	2	3	4	5	6	7	8
4	Developing paragraphs (introductions, transitions, and conclusions)	1	2	3	4	5	6	7	8
5	Writing grammatically correct sentences	1	2	3	4	5	6	7	8
6	Notetaking and quoting	1	2	3	4	5	6	7	8
7	Editing and revising	1	2	3	4	5	6	7	8
8	Other (Please specify) _____								

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information. (Circle number)

	Information Technologies	I already use it	I don't use it, but may in the future	I don't use it and doubt if I will
1	Audio tapes and cassettes	1	2	3
2	Motion picture film	1	2	3
3	Video tape	1	2	3
4	Desktop /electronic publishing	1	2	3
5	Computer cassette/cartridge tapes	1	2	3
6	Electronic mail	1	2	3
7	Electronic bulletin boards	1	2	3
8	FAX or TELEX	1	2	3
9	Electronic data bases	1	2	3
10	Video conferencing	1	2	3
11	Computer conferencing	1	2	3
12	Micrographics & microforms	1	2	3

15. Do you ever use electronic (computer) networks? (Circle number)

1 Yes, I personally use them
2 Yes, I use them but through an intermediary
3 No
4 No because I do not have access to electronic networks } Go to Question 18.
5 No but may use them in the future

If you answered "no" to Question 15, please go to Question 18. If you answered "yes" to Question 15, please continue to Question 16.

16. Do you use electronic networks for the following purposes? (Circle number)

		Yes	No
1	To connect to geographically distant sites	1	2
2	For electronic mail	1	2
3	For electronic bulletin boards or conferences	1	2
4	For electronic file transfer	1	2
5	To log into computers for such things as computational analysis or to use design tools	1	2
6	To control equipment such as laboratory instruments or machine tools	1	2
7	To access/search the library's catalogue	1	2
8	To order documents from the library	1	2
9	To search electronic (bibliographic) data bases	1	2
10	For information search and data retrieval	1	2
11	To prepare scientific and technical papers with colleagues at geographically distant sites	1	2

17. Do you exchange electronic messages or files with: (Circle number)

		Yes	No
1	Members of your academic classes	1	2
2	Other people in your academic community at the **SAME** geographic site who are not in your academic classes	1	2
3	Other people in your academic community at a **DIFFERENT** geographic site who are not in your academic classes	1	2
4	People outside of your academic community	1	2

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

_____ number of times

If you answered "0" times to Question 18, please go to Question 20. If you answered "1 or more" times to Question 18, please continue to Question 19.

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs? (Circle number) } Go to Question 21.

Very Ineffective						Very Effective	Don't Know
1	2	3	4	5	6	7	8

20. Which of the following statements best describes your reasons for not using a library during this current school term? (Circle ALL that apply)

		Yes	No
1	I had no information needs	1	2
2	My information needs were more easily met some other way	1	2
3	Tried the library once or twice before but I couldn't find the information I needed	1	2
4	The library is physically too far away	1	2
5	The library staff is not cooperative or helpful	1	2
6	The library staff does not understand my information needs	1	2
7	The library did not have the information I need	1	2
8	I have my own personal library and do not need another library	1	2
9	The library is too slow in getting the information I need	1	2
10	We have to pay to use the library	1	2
11	We are discouraged from using the library	1	2

21. As part of your academic preparation, have you received or participated in the following library activities? (Circle ALL that apply)

		Yes	No	Not Available	Don't Know
1	Library tour	1	2	6	8
2	Library presentation as part of academic orientation	1	2	6	8
3	Library orientation as part of an engineering/ science course	1	2	6	8
4	Library skill/use course (bibliographic instruction)	1	2	6	8
5	Library skill/use course in engineering/science information resources and materials	1	2	6	8
6	Library instruction for end-user searching of electronic (bibliographic) data bases	1	2	6	8

22. Which ONE of the following BEST characterizes your use of electronic (bibliographic) data bases? (Circle ONLY ONE number)

1 I do **all** searches myself
2 I do **most** searches myself
3 I do **half** by myself and **half** through a librarian
4 I do **most** searches through a librarian
5 I do **all** searches through a librarian
6 I do **not use** electronic data bases
7 I do not have access to electronic data bases

These questions ask about the use and importance of information to engineering/ science students.

23. How OFTEN during this current school term have you used the following information sources to meet your engineering/science information needs? (Circle numbers)

		Never	Seldom	Sometimes	Frequently	Always	Not Available
1	Your personal collection of information	1	2	3	4	5	6
2	Other students	1	2	3	4	5	6
3	Faculty members	1	2	3	4	5	6
4	Library	1	2	3	4	5	6
5	Librarian	1	2	3	4	5	6
6	Your personal contacts within industry	1	2	3	4	5	6
7	Your personal contacts at government laboratories	1	2	3	4	5	6

24. How OFTEN during this current school term have you used the following information products to meet your engineering/science information needs? (Circle numbers)

		Never	Seldom	Sometimes	Frequently	Always	Not Available
1	Abstracts	1	2	3	4	5	6
2	Conference/meeting papers	1	2	3	4	5	6
3	Journal articles	1	2	3	4	5	6
4	Handbooks	1	2	3	4	5	6
5	Textbooks	1	2	3	4	5	6
6	Computer programs and documentation	1	2	3	4	5	6
7	Bibliographic, numeric, factual data bases	1	2	3	4	5	6
8	Theses/dissertations	1	2	3	4	5	6
9	Technical reports	1	2	3	4	5	6
10	Audio/visual materials	1	2	3	4	5	6
11	Foreign language technical reports	1	2	3	4	5	6
12	Technical translations	1	2	3	4	5	6
13	Patents	1	2	3	4	5	6
14	Industry technical reports	1	2	3	4	5	6
15	Drawings/specifications	1	2	3	4	5	6
16	Preprints or deposited manuscripts	1	2	3	4	5	6
17	Informal information products e.g., vendor/supply catalogs, company literature, trade journals/magazines)	1	2	3	4	5	6

25. How IMPORTANT are the following information sources in meeting your engineering/ science information needs? (Circle numbers)

		Very Unimportant						Very Important	Not Available
1	Your personal collection of information	1	2	3	4	5	6	7	8
2	Other students	1	2	3	4	5	6	7	8
3	Faculty members	1	2	3	4	5	6	7	8
4	Library	1	2	3	4	5	6	7	8
5	Librarian	1	2	3	4	5	6	7	8
6	Your personal contacts within industry	1	2	3	4	5	6	7	8
7	Your personal contacts at government laboratories	1	2	3	4	5	6	7	8

26. How IMPORTANT are the following information products in meeting your engineering/ science information needs? (Circle numbers)

		Very Unimportant						Very Important	Not Available
1	Abstracts	1	2	3	4	5	6	7	8
2	Conference/meeting papers	1	2	3	4	5	6	7	8
3	Journal articles	1	2	3	4	5	6	7	8
4	Handbooks	1	2	3	4	5	6	7	8
5	Textbooks	1	2	3	4	5	6	7	8
6	Computer programs and documentation	1	2	3	4	5	6	7	8
7	Bibliographic, numeric, factual data bases	1	2	3	4	5	6	7	8
8	Theses/dissertations	1	2	3	4	5	6	7	8
9	Technical reports	1	2	3	4	5	6	7	8
10	Audio/visual materials	1	2	3	4	5	6	7	8
11	Foreign language technical reports	1	2	3	4	5	6	7	8
12	Technical translations	1	2	3	4	5	6	7	8
13	Patents	1	2	3	4	5	6	7	8
14	Industry technical reports	1	2	3	4	5	6	7	8
15	Drawings/specifications	1	2	3	4	5	6	7	8
16	Preprints or deposited manuscripts	1	2	3	4	5	6	7	8
17	Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	1	2	3	4	5	6	7	8

27. Do you use information from the following countries in meeting your engineering/science information needs? (Circle numbers)

		Yes	No	Don't Have Access
1	Australia	1	2	6
2	China	1	2	6
3	France	1	2	6
4	Germany	1	2	6
5	India	1	2	6
6	Japan	1	2	6
7	Netherlands	1	2	6
8	Russia	1	2	6
9	United Kingdom	1	2	6
10	United States	1	2	6

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment? Please sequence these items (e.g., #1, #2, #3, #4, #5) and mark an X beside the step(s) you DID NOT USE.

Sequence

____ Used my personal store of technical information
____ Spoke with other students
____ Spoke with faculty members
____ Used literature resources (e.g., conference papers, journal articles, technical reports)
____ Spoke with a librarian
____ Used literature resources found in a library
____ Used none of the above steps
____ Searched (or had someone search for me) an electronic (bibliographic) database in the library.

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender? (Circle number)

1 Female
2 Male

30. What is your educational status? (Circle number)

1 Undergraduate
2 Graduate
3 Other (Please specify) _____

31. What is your engineering/science major? (Circle number)

1	Aeronautical/Astronautical	7	Physics
2	Chemical	8	Agricultural
3	Civil	9	Computer Science
4	Electrical and Computer	10	Materials Science
5	Mechanical and Industrial	11	General Engineering
6	Nuclear	12	Theoretical & Applied Mechanics

32. What is your native language?

Please specify _____

33. What is your native country?

Please specify _____

34. Are you a citizen of the country where you are attending school? (Circle number)

1 Yes

2 No

35. How well do you read the following languages? (Circle numbers)

		Passably				Fluently	Do not Read This Language
1	English	1	2	3	4	5	6
2	French	1	2	3	4	5	6
3	German	1	2	3	4	5	6
4	Japanese	1	2	3	4	5	6
5	Russian	1	2	3	4	5	6
6	Other (please specify) _____						

36. How well do you speak the following languages? (Circle numbers)

		Passably				Fluently	Do not Speak This Language
1	English	1	2	3	4	5	6
2	French	1	2	3	4	5	6
3	German	1	2	3	4	5	6
4	Japanese	1	2	3	4	5	6
5	Russian	1	2	3	4	5	6
6	Other (please specify) _____						

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual (i.e., read and speak more than one language)? (Circle number)

Very Unimportant						Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9

38. In what type of organization do you hope to work after graduation? (Circle number)

1 Academic
2 Government
3 Industry (national)
4 Industry (multi-national)
5 NOT for profit
6 Other (please specify) _____

39. When you were growing up, do you think your family's income was: (Circle number)

1 Much higher than that of most families in your native country
2 Higher than that of most families in your native country
3 About equal to the average family income in your native country
4 Lower than that of most families in your native country
5 Much lower than that of most families in your native country
6 I cannot compare my family's income with incomes of other families

40. Do you own a personal computer? (Circle number)

1 Yes

2 No

41. As a high school student, how often did you use your: (Circle number)

	Never	Seldom	Sometimes	Frequently	Always	Not Available
2 High school library	1	2	3	4	5	6
3 Public library	1	2	3	4	5	6

42. As an engineering or physics major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading (keeping current with) the professional literature associated with your discipline?

_____ hours each week

43. Are you a member of a professional student (national) engineering, scientific, or technical society? (Circle number)

1 Yes

2 No

APPENDIX C

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	1.2	0.8	1.8	3.7	14.9	28.4	49.1
Advance to a high-level staff technical position	2.7	3.6	6.8	16.3	29.2	20.8	20.6
Have the opportunity to work on complex technical problems	1.1	2.3	5.4	11.3	24.0	27.8	28.1
Work on projects that utilize the latest theoretical results in your specialty	1.4	3.6	7.0	15.9	23.0	25.1	24.0
Work on projects that require learning new technical knowledge	1.0	1.2	3.2	10.5	21.2	34.8	28.0
Establish a reputation outside your organization as an authority in your field	3.1	4.6	9.0	16.1	21.0	22.8	23.4
Receive patents for your ideas	10.9	12.1	16.7	22.8	17.8	10.2	9.5
Publish articles in technical journals	7.0	9.4	14.2	18.6	19.0	16.0	15.9
Communicate your ideas to others in your profession through papers delivered at professional society meetings	4.6	8.6	12.4	19.2	22.4	17.9	14.8
Be evaluated on the basis of your technical contributions	2.7	3.2	6.9	16.2	26.7	24.8	19.5
Become a manager or director in your line of work	6.9	5.6	11.2	16.1	20.3	22.0	17.9
Plan and coordinate the work of others	4.3	5.7	9.8	16.2	23.1	22.3	18.6
Advance to a policy-making position in management	8.9	8.7	12.7	18.2	18.4	16.8	16.3
Plan projects and make decisions affecting the organization	3.5	4.2	6.7	14.3	22.7	25.5	23.2
Be the technical leader of a group of less experienced professionals	2.6	4.2	8.6	17.5	25.8	24.2	17.1

University of Illinois at Urbana-Champaign

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	NA 9 %
Your parents encouraged your area of study/major	17.8	12.8	10.8	17.3	16.8	11.3	9.2	4.0
Other family members encouraged your area of study/major	26.0	17.9	10.9	16.3	9.6	5.1	4.6	9.5
Teachers encouraged your area of study/major	14.9	12.5	12.5	21.1	18.5	10.6	5.7	4.2
You feel that a career in your major/area of study will lead to financial security	6.0	6.5	10.1	15.2	23.0	20.0	18.6	0.5
You feel that a career in your major/area of study will provide a career with many rewarding activities	0.7	1.1	1.7	6.1	15.3	29.7	45.2	0.1
Information on the career opportunities available in your major/area of study	9.0	6.8	11.9	21.5	22.1	15.8	9.4	3.4

3. When did you first decide on your area of study/major?

While still in elementary school	6.5
While in high school (or equivalent)	63.3
When you started college (or equivalent)	12.0
After starting college (or equivalent)	16.0
Other	2.3

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	38.4
I feel about the same now as when I first made it	43.8
I am less happy about my career choice now than when I first made it	17.7

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	0.8	0.6	2.4	5.1	14.7	28.1	48.3
Effectively communicate technical information orally	0.8	0.3	1.5	5.4	14.6	28.4	49.0
Have a knowledge and understanding of engineering/science information resources and materials	0.6	0.6	1.2	4.2	18.3	33.1	42.0
Be able to search electronic (bibliographic) data bases	1.2	1.9	5.5	14.5	27.7	25.3	23.9
Know how to use a library that contains engineering/science information resources and materials	1.0	1.6	4.1	12.0	24.3	28.5	28.6
Effectively use computer, communication, and information technology	1.3	0.3	0.8	1.9	7.2	21.8	66.6

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	60.7	37.3	1.9
Speech/oral communication	48.6	49.0	2.4
Using a library that contains engineering/science information resources and materials	43.5	50.9	5.6
Using engineering/science information resources and materials	45.8	49.4	4.8
Searching electronic (bibliographic) data bases	49.0	46.7	4.3
Using computer, communication, and information technology	78.8	19.2	2.0

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful 1 %	2 %	3 %	4 %	5 %	6 %	Very Helpful 7 %	No Training 10 %
Technical writing/communication	1.2	2.6	4.5	11.6	19.6	11.0	11.6	38.0
Speech/oral communication	0.9	2.4	4.9	8.0	14.1	9.8	10.6	49.3
Using a library that contains engineering/science information resources and materials	0.9	1.5	4.7	9.6	12.7	8.1	6.9	55.6
Using engineering/science information resources and materials	0.6	1.4	4.1	8.9	15.3	9.6	7.4	52.7
Searching electronic (bibliographic) data bases	0.9	2.2	4.8	9.2	12.9	10.4	10.0	49.6
Using computer, communication, and information technology	1.4	2.0	3.8	7.9	12.1	18.6	31.7	22.5

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	30.8%
1 through 25 percent	27.5%
26 through 50 percent	19.7%
51 through 75 percent	8.5%
76 through 99 percent	7.7%
100 percent	6.1%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	11.2%
1 through 25 percent	28.0%
26 through 50 percent	34.6%
51 through 75 percent	8.6%
76 through 99 percent	6.4%
100 percent	11.3%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	32.3%
About as productive as writing alone	24.8%
More productive than writing alone	42.8%

11. Do you use a computer to prepare written technical communication?

Never	2.8%
Sometimes	6.5%
Frequently	12.5%
Always	78.3%

12. Which of the following best explains your reasons for non-use?

No or limited computer access	12.9%
Lack of knowledge/skill using a computer	25.8%
Prefer not to use a computer	12.9%
Other	54.8%

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede 1 %	2 %	3 %	4 %	5 %	6 %	Greatly Impedes 7 %
Defining the purpose of the communication	23.6	19.3	11.3	14.9	12.0	9.0	9.9
Assessing the needs of the reader	13.1	13.8	17.8	19.8	18.4	10.9	6.3
Preparing/presenting information in an organized manner	20.8	18.4	14.0	12.2	12.7	12.7	9.3
Developing paragraphs (introductions, transitions, and conclusions)	25.8	19.2	11.5	15.0	13.9	8.3	6.4
Writing grammatically correct sentences	38.6	16.6	10.4	10.9	10.5	6.5	6.5
Notetaking and quoting	25.2	19.5	17.3	16.5	12.5	6.5	2.5
Editing and revising	24.0	17.7	15.5	16.4	12.5	7.5	6.3

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it 1 %	I don't use it, but may in the future 2 %	I don't use it and doubt if I will 3 %
Audio tapes and cassettes	11.0	31.9	57.2
Motion picture film	5.3	31.8	62.9
Video tape	21.0	59.0	20.0
Desktop/electronic publishing	61.2	35.0	3.8
Computer cassette/cartridge tapes	25.8	46.7	27.4
Electronic mail	75.8	22.3	1.9
Electronic bulletin boards	47.6	46.6	5.8
FAX or TELEX	43.9	53.7	2.4
Electronic data bases	51.8	45.7	2.6
Video conferencing	2.6	77.6	19.8
Computer conferencing	11.1	76.4	12.5
Micrographics & microforms	18.0	57.7	24.3

15. Do you ever use electronic networks?

Yes, I personally use them	82.4%
Yes, I use them but through an intermediary	7.1%
No	2.7%
No, because I do not have access	1.1%
No, but I may use them in the future	6.7%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	68.9	31.1
For electronic mail	93.1	6.9
For electronic bulletin boards or conferences	61.5	38.5
For electronic file transfer	74.9	25.1
To log into computers for such things as computational analysis or to use design tools	66.5	33.5
To control equipment such as laboratory instruments or machine tools	18.5	81.5
To access/search the library's catalogue	83.9	16.1
To order documents from the library	58.9	41.1
To search electronic (bibliographic) data bases	70.7	29.3
For information search and data retrieval	62.6	37.4
To prepare scientific and technical papers with colleagues at geographically distant sites	16.9	83.1

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	80.6	19.4
Other people in your academic community at the same geographic site who are not in your academic classes	73.2	26.8
Other people in your academic community at a different geographic site who are not in your academic classes	61.5	38.5
People outside your academic community	69.4	30.6

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	22.7%
1 through 25 times	68.9%
26 through 50 times	6.9%
51 through 75 times	0.4%
More than 75 times	1.2%

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective						Very Effective
1	2	3	4	5	6	7
%	%	%	%	%	%	%
2.2	3.7	7.3	11.7	25.9	29.0	20.1

20. Which of the following statements best describes your reasons for not using a library during this current school term?

	Yes 1 %	No 2 %
I had no information needs	81.3	18.7
My information needs were more easily met some other way	63.0	37.0
Tried the library once or twice before but I couldn't find the information I needed	15.7	84.3
The library is physically too far away	8.1	91.9
The library staff is not cooperative or helpful	3.5	96.5
The library staff does not understand my information needs	4.5	95.5
The library did not have the information I need	12.8	87.2
I have my own personal library and do not need another library	10.8	89.2
The library is too slow in getting the information I need	10.3	89.7
We have to pay to use the library	1.0	99.0
We are discouraged from using the library	3.4	96.6

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes 1 %	No 2 %	Not Available 6 %
Library tour	48.4	48.3	3.3
Library presentation as part of academic orientation	40.9	54.0	5.1
Library orientation as part of an engineering/ science course	15.6	74.5	9.9
Library skill/use course (bibliographic instruction)	25.3	68.6	6.1
Library skill/use course in engineering/science information resources and materials	12.2	78.4	9.4
Library instruction for end-user searching of electronic (bibliographic) data bases	28.9	64.8	6.3

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	45.9%
I do most searches myself	36.3%
I do half by myself and half through a librarian	4.6%
I do most searches through a librarian	2.3%
I do all searches through a librarian	0.6%
I do not use electronic data bases	9.4%
I do not have access to electronic data bases	1.0%

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	3.5	6.5	17.8	48.5	22.5	1.1
Other students	6.0	17.4	34.0	36.9	5.0	0.6
Faculty members	10.6	21.7	37.8	24.5	4.4	1.0
Library	18.1	21.2	25.1	26.8	8.4	0.4
Librarian	47.6	32.6	15.2	3.1	0.7	0.8
Your personal contacts within industry	48.3	20.8	13.6	4.3	0.9	12.1
Your personal contacts at government laboratories	61.9	10.3	5.1	2.4	0.4	19.9

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	42.1	17.6	21.4	14.9	2.7	1.3
Conference/meeting papers	42.5	12.7	19.2	19.1	4.7	1.8
Journal articles	22.4	11.5	21.2	31.3	13.0	0.6
Handbooks	27.5	20.6	25.5	21.1	4.3	1.0
Textbooks	2.9	4.5	17.6	42.9	31.8	0.3
Computer programs & documentation	18.3	18.7	23.8	28.9	9.7	0.6
Bibliographic, numeric, factual data bases	41.5	25.3	20.2	10.1	1.8	1.2
Theses/dissertations	52.9	18.6	18.2	8.4	0.9	1.1
Technical reports	35.9	22.1	24.5	14.9	1.9	0.8
Audio/visual materials	71.1	17.2	8.4	2.1	0.1	1.1
Foreign language technical reports	85.9	8.4	2.8	0.6	0.4	1.9
Technical translations	79.8	13.3	4.2	0.5	0.1	2.1
Patents	91.0	5.7	1.1	0.1	0.1	2.0
Industry technical reports	66.1	18.3	11.0	3.1	0.0	1.5
Drawings/specifications	59.7	18.8	14.1	5.3	0.7	1.3
Preprints or deposited manuscripts	69.5	14.4	10.2	4.0	0.4	1.5
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	38.8	21.9	23.3	12.4	2.2	1.3

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Your personal collection of information	3.2	3.4	5.6	8.7	14.5	19.6	44.2	0.9
Other students	4.3	9.0	11.7	19.1	20.7	19.4	15.6	0.4
Faculty members	3.8	6.1	11.2	17.8	22.2	19.3	18.8	0.8
Library	8.3	8.9	11.0	14.2	15.3	16.9	25.1	0.4
Librarian	29.4	23.8	16.9	14.0	7.1	4.8	3.5	0.5
Your personal contacts within industry	29.5	14.3	10.6	13.7	6.9	4.7	3.1	17.1
Your personal contacts at government laboratories	39.8	11.0	6.1	7.7	4.0	2.3	1.9	27.2

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Abstracts	29.3	12.2	11.0	14.3	11.5	8.7	10.3	2.8
Conference/meeting papers	27.6	10.7	10.7	10.9	9.5	12.1	15.3	3.1
Journal articles	14.5	4.9	7.5	10.3	12.2	17.5	31.5	1.6
Handbooks	15.5	10.7	11.9	18.5	14.7	13.8	13.2	1.7
Textbooks	1.2	1.8	3.3	10.0	15.7	22.8	44.8	0.4
Computer programs and documentation	10.9	8.7	8.7	16.5	16.0	18.6	19.7	1.0
Bibliographic, numeric, factual data bases	24.8	13.0	14.9	15.5	12.3	9.3	7.9	2.4
Theses/dissertations	30.6	14.4	12.3	14.7	11.8	7.8	6.1	2.2
Technical reports	23.4	11.7	11.7	17.2	16.0	11.5	7.1	1.3
Audio/visual materials	49.0	17.4	10.8	9.5	6.1	2.8	2.0	2.4
Foreign language technical reports	63.3	16.1	6.5	4.7	2.7	1.2	1.4	4.0
Technical translations	56.2	16.8	8.2	7.2	3.8	2.1	1.7	4.0
Patents	64.0	16.0	6.4	5.1	2.7	0.8	0.9	4.2
Industry technical reports	41.6	14.8	12.6	12.3	8.3	4.6	2.3	3.3
Drawings/specifications	42.2	14.2	10.5	12.8	8.3	5.2	3.8	3.0
Preprints or deposited manuscripts	49.5	13.7	9.0	11.5	5.6	4.1	3.0	3.7
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	31.8	13.5	12.1	14.4	12.9	7.4	5.9	2.1

27. Do you use information from the following countries in meeting your engineering/science information needs?

	Yes 1 %	No 2 %	Don't Have Access 6 %
Australia	10.8	78.6	10.6
China	6.4	82.1	11.5
France	19.4	70.3	10.4
Germany	27.9	62.1	10.0
India	8.0	80.8	11.2
Japan	29.2	61.0	9.8
Netherlands	11.9	77.0	11.2
Russia	14.9	73.7	11.4
United Kingdom	38.0	53.8	8.2
United States	88.3	9.5	2.2

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1 %	2 %	3 %	4 %	Steps 5 through 7 %	Did Not Use 0 %
Used my personal store of technical information	53.0	13.4	10.7	6.7	6.7	9.5
Spoke with other students	12.0	34.1	13.4	9.4	14.8	16.3
Spoke with faculty members	17.8	18.1	27.4	9.4	13.0	14.3
Used literature resources	7.0	15.9	17.4	20.0	13.6	26.1
Spoke with a librarian	0.9	1.6	2.9	4.1	15.0	75.5
Used literature resources found in a library	2.6	8.0	15.2	17.2	24.2	32.7
Searched an electronic data base in the library	7.5	9.4	10.7	11.4	16.8	44.2
Used none of the above steps	1.5	-----	-----	-----	-----	-----

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	16.7%
Male	83.3%

30. What is your educational status?

Undergraduate	54.6%
Graduate	45.0%
Other	0.4%

31. What is your engineering/science major?

Aeronautical/Astronautical	7.8%
Chemical	2.7%
Civil	15.8%
Electrical & Computer	29.3%
Mechanical & Industrial	18.5%
Nuclear	3.1%
Physics	7.4%
Agricultural	0.0%
Computer Science	15.1%
Materials Science	0.1%
General Engineering	0.3%
Theoretical & Applied Mechanics	0.0%

32. What is your native language?

Chinese	4.7%
English	81.0%
Farsi	0.4%
French	0.4%
German	0.4%
Greek	0.3%
Hindi	1.0%
Japanese	0.2%
Korean	1.4%
Malayalam	0.3%
Portuguese	0.7%
Romanian	0.3%
Russian	0.4%
Spanish	2.3%
Tagalog	0.2%
Tamil	0.6%
Telugu	0.5%
Turkish	0.4%
Vietnamese	0.6%
Arabic	0.3%
Other	3.8%

33. What is your native country?

Brazil	0.6%
Canada	0.9%
China	2.4%
France	0.4%
Germany	0.3%
Hong Kong	0.5%
India	3.7%
Iran	0.2%
Japan	0.1%
Korea	2.1%
Malaysia	0.6%
Mexico	0.6%
Philippines	0.4%
Romania	0.3%
Russia	0.4%
Singapore	0.2%
Taiwan	1.6%
USA	78.1%
Vietnam	0.7%
Greece	0.1%
Other	6.0%

34. Are a citizen of the country where you are attending school?

Yes	85.4%
No	14.6%

35. How well do you read the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not read this language 6 %
English	0.2	0.0	0.4	2.6	95.1	1.8
French	12.6	5.0	6.5	2.4	1.7	71.8
German	12.6	2.3	4.3	1.6	1.7	77.4
Japanese	2.6	0.9	0.5	0.4	0.5	95.2
Russian	1.9	0.6	0.6	0.4	0.8	95.6
Spanish	37.1	18.0	24.0	13.2	7.8	0.0
Other	25.3	6.7	8.0	9.3	50.7	0.0

36. How well do you speak the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not speak this language 6 %
English	0.0	0.4	1.6	4.6	91.7	1.8
French	11.6	4.5	4.3	1.9	1.5	76.1
German	11.1	3.4	2.5	1.3	2.2	79.6
Japanese	3.3	0.5	0.5	0.2	0.5	95.1
Russian	2.0	0.6	0.4	0.6	0.9	95.4
Spanish	38.8	18.4	25.9	8.2	8.8	0.0
Other	26.3	3.8	11.3	8.8	50.0	0.0

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant						Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9
%	%	%	%	%	%	%	%	%
11.0	10.8	8.2	9.3	11.0	6.7	16.4	18.4	8.2

38. In what type of organization do you hope to work after graduation?

Academic	22.7%
Government	12.6%
Industry (national)	38.1%
Industry (multi-national)	33.7%
Not for profit	2.2%
Other	4.7%

39. When you were growing up; do you think your family's income was:

Much higher than that of most families in your native country	3.6%	
Higher than that of most families in your native country	35.1%	
About equal to the average family income in your native country	45.1%	
Lower than that of most families in your native country	12.4%	
Much lower than that of most families in your native country		2.1%
I cannot compare my family's income with incomes of other families	1.6%	

40. Do you own a personal computer?

Yes	52.1%
No	47.9%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	7.3	28.3	35.0	23.4	5.1	0.9
Public library	9.3	24.8	30.2	25.9	7.9	1.8

42. As an engineering or physics major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading the professional literature associated with your discipline?

0 hours	17.1%
1 through 5 hours	67.6%
6 through 10 hours	9.5%
11 through 25 hours	4.4%
More than 25 hours	1.3%

43. Are you a member of a professional student (national) engineering, scientific, or technical society?

Yes	65.3%
No	34.7%

APPENDIX D

BOWLING GREEN STATE UNIVERSITY

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	2.9	0.0	1.5	2.9	22.1	26.5	44.1
Advance to a high-level staff technical position	3.0	1.5	3.0	19.4	28.4	25.4	19.4
Have the opportunity to work on complex technical problems	3.0	0.0	3.0	14.9	22.4	29.9	26.9
Work on projects that utilize the latest theoretical results in your specialty	3.0	1.5	1.5	11.9	23.9	29.9	28.4
Work on projects that require learning new technical knowledge	1.5	1.5	2.9	4.4	25.0	33.8	30.9
Establish a reputation outside your organization as an authority in your field	3.0	1.5	4.5	7.5	29.9	19.4	34.3
Receive patents for your ideas	7.7	10.8	7.7	26.2	18.5	16.9	12.3
Publish articles in technical journals	16.2	13.2	19.1	20.6	17.6	7.4	5.9
Communicate your ideas to others in your profession through papers delivered at professional society meetings	13.2	7.4	16.2	17.6	23.5	14.7	7.4
Be evaluated on the basis of your technical contributions	7.5	3.0	6.0	14.9	28.4	28.4	11.9
Become a manager or director in your line of work	3.0	1.5	6.0	16.4	23.9	28.4	20.9
Plan and coordinate the work of others	1.5	5.9	2.9	17.6	20.6	30.9	20.6
Advance to a policy-making position in management	6.0	4.5	7.5	22.4	23.9	19.4	16.4
Plan projects and make decisions affecting the organization	1.5	2.9	4.4	11.8	20.6	32.4	26.5
Be the technical leader of a group of less experienced professionals	1.5	0.0	5.9	13.2	23.5	33.8	22.1

Bowling Green State University

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	NA 9 %
Your parents encouraged your area of study/major	29.4	11.8	13.2	16.2	10.3	5.9	5.9	7.4
Other family members encouraged your area of study/major	23.5	16.2	13.2	19.1	11.8	2.9	4.4	8.8
Teachers encouraged your area of study/major	22.1	14.7	14.7	23.5	5.9	5.9	5.9	7.4
You feel that a career in your major/area of study will lead to financial security	1.5	1.5	4.4	17.6	27.9	25.0	20.6	1.5
You feel that a career in your major/area of study will provide a career with many rewarding activities	0.0	0.0	2.9	5.9	8.8	36.8	44.1	1.5
Information on the career opportunities available in your major/area of study	2.9	2.9	7.4	25.0	26.5	19.1	14.7	1.5

3. When did you first decide on your area of study/major?

While still in elementary school	14.7%
While in high school (or equivalent)	38.2%
When you started college (or equivalent)	22.1%
After starting college (or equivalent)	22.1%
Other	2.9%

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	52.9%
I feel about the same now as when I first made it	35.3%
I am less happy about my career choice now than when I first made it	11.8%

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	3.0	3.0	1.5	9.0	25.4	16.4	41.8
Effectively communicate technical information orally	1.5	1.5	0.0	3.0	13.4	26.9	53.7
Have a knowledge and understanding of engineering/science information resources and materials	1.5	1.5	0.0	4.5	9.1	43.9	39.4
Be able to search electronic (bibliographic) data bases	3.0	3.0	9.1	13.6	21.2	33.3	16.7
Know how to use a library that contains engineering/science information resources and materials	1.5	1.5	4.5	15.2	22.7	31.8	22.7
Effectively use computer, communication, and information technology	3.0	0.0	0.0	6.0	6.0	19.4	65.7

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	85.3	13.2	1.5
Speech/oral communication	83.8	14.7	1.5
Using a library that contains engineering/science information resources and materials	77.9	17.6	4.4
Using engineering/science information resources and materials	82.4	14.7	2.9
Searching electronic (bibliographic) data bases	67.6	29.4	2.9
Using computer, communication, and information technology	98.5	1.5	0.0

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful 1 %	2 %	3 %	4 %	5 %	6 %	Very Helpful 7 %	No Training 10 %
Technical writing/communication	1.5	2.9	4.4	11.8	17.6	20.6	27.9	13.2
Speech/oral communication	0.0	1.5	3.0	13.4	22.4	19.4	29.9	10.4
Using a library that contains engineering/science information resources and materials	1.5	1.5	4.5	10.4	22.4	26.9	14.9	17.9
Using engineering/science information resources and materials	1.5	3.0	4.5	17.9	9.0	34.3	16.4	13.4
Searching electronic (bibliographic) data bases	1.5	4.4	5.9	10.3	23.5	14.7	16.2	23.5
Using computer, communication, and information technology	1.5	0.0	1.5	7.4	8.8	29.4	51.5	0.0

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	8.1%
1 through 25 percent	37.0%
26 through 50 percent	29.0%
51 through 75 percent	11.3%
76 through 99 percent	14.5%
100 percent	0.0%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	0.0%
1 through 25 percent	29.4%
26 through 50 percent	49.1%
51 through 75 percent	9.8%
76 through 99 percent	2.0%
100 percent	9.8%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	40.4%
About as productive as writing alone	24.6%
More productive than writing alone	35.1%

11. Do you use a computer to prepare written technical communication?

Never	0.0%
Sometimes	9.0%
Frequently	26.9%
Always	64.2%

12. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede 1 %	2 %	3 %	4 %	5 %	6 %	Greatly Impedes 7 %
Defining the purpose of the communication	14.1	18.8	15.6	17.2	17.2	12.5	4.7
Assessing the needs of the reader	10.8	16.9	10.8	27.7	20.0	9.2	4.6
Preparing/presenting information in an organized manner	20.0	13.8	10.8	13.8	15.4	12.3	13.8
Developing paragraphs (introductions, transitions, and conclusions)	20.0	20.0	10.8	9.2	18.5	16.9	4.6
Writing grammatically correct sentences	16.9	20.0	16.9	13.8	15.4	10.8	6.2
Notetaking and quoting	16.7	18.2	18.2	16.7	16.7	10.6	3.0
Editing and revising	12.7	22.2	14.3	19.0	12.7	14.3	4.8

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it 1 %	I don't use it, but may in the future 2 %	I don't use it and doubt if I will 3 %
Audio tapes and cassettes	38.2	44.1	17.6
Motion picture film	20.9	41.8	37.3
Video tape	69.1	26.5	4.4
Desktop/electronic publishing	66.2	22.1	11.8
Computer cassette/cartridge tapes	32.4	50.0	17.6
Electronic mail	25.0	66.2	8.8
Electronic bulletin boards	11.8	75.0	13.2
FAX or TELEX	50.0	47.1	2.9
Electronic data bases	57.4	39.7	2.9
Video conferencing	8.8	85.3	5.9
Computer conferencing	10.3	82.4	7.4
Micrographics & microforms	38.2	52.9	8.8

15. Do you ever use electronic networks?

Yes, I personally use them	26.9%
Yes, I use them but through an intermediary	26.9%
No	19.4%
No, because I do not have access	11.9%
No, but I may use them in the future	14.9%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	38.2	61.8
For electronic mail	47.1	52.9
For electronic bulletin boards or conferences	26.5	73.5
For electronic file transfer	45.5	54.5
To log into computers for such things as computational analysis or to use design tools	67.7	32.4
To control equipment such as laboratory instruments or machine tools	44.1	55.9
To access/search the library's catalogue	82.4	17.6
To order documents from the library	38.2	61.8
To search electronic (bibliographic) data bases	73.5	26.5
For information search and data retrieval	80.0	20.0
To prepare scientific and technical papers with colleagues at geographically distant sites	23.5	76.5

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	23.5	76.5
Other people in your academic community at the same geographic site who are not in your academic classes	26.5	73.5
Other people in your academic community at a different geographic site who are not in your academic classes	26.5	73.5
People outside your academic community	41.2	58.8

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	10.3%
1 through 25 times	85.5%
26 through 50 times	3.0%
51 through 75 times	1.5%
More than 75 times	0.0%

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective						Very Effective
1	2	3	4	5	6	7
%	%	%	%	%	%	%
3.3	5.0	6.7	20.0	31.7	13.3	20.0

20. Which of the following statements best describes your reasons for not using a library during this current school term?

	Yes 1 %	No 2 %
I had no information needs	71.4	28.6
My information needs were more easily met some other way	71.4	28.6
Tried the library once or twice before but I couldn't find the information I needed	14.3	85.7
The library is physically too far away	28.6	71.4
The library staff is not cooperative or helpful	14.3	85.7
The library staff does not understand my information needs	42.9	57.1
The library did not have the information I need	28.6	71.4
I have my own personal library and do not need another library	14.3	85.7
The library is too slow in getting the information I need	28.6	71.4
We have to pay to use the library	0.0	100.0
We are discouraged from using the library	0.0	100.0

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes 1 %	No 2 %	Not Available 6 %
Library tour	75.4	21.5	3.1
Library presentation as part of academic orientation	46.2	47.7	6.2
Library orientation as part of an engineering/ science course	12.3	72.3	15.4
Library skill/use course (bibliographic instruction)	50.0	41.9	8.1
Library skill/use course in engineering/science information resources and materials	25.8	62.9	11.3
Library instruction for end-user searching of electronic (bibliographic) data bases	38.7	50.0	11.3

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	43.9%
I do most searches myself	34.8%
I do half by myself and half through a librarian	4.5%
I do most searches through a librarian	1.5%
I do all searches through a librarian	0.0%
I do not use electronic data bases	12.1%
I do not have access to electronic data bases	3.0%

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	7.5	14.9	35.8	28.4	9.0	4.5
Other students	7.5	26.9	35.8	26.9	3.0	0.0
Faculty members	3.0	23.9	25.4	37.3	9.0	1.5
Library	4.5	12.1	18.2	47.0	16.7	1.5
Librarian	26.9	40.3	23.9	7.5	0.0	1.5
Your personal contacts within industry	9.0	17.9	26.9	32.8	7.5	6.0
Your personal contacts at government laboratories	56.1	10.6	7.6	7.6	1.5	16.7

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	14.9	22.4	29.9	26.9	3.0	3.0
Conference/meeting papers	35.8	31.3	20.9	10.4	0.0	1.5
Journal articles	6.0	17.9	22.4	38.8	13.4	1.5
Handbooks	9.2	15.4	24.6	40.0	9.2	1.5
Textbooks	0.0	4.5	16.4	43.3	34.3	1.5
Computer programs & documentation	13.4	17.9	19.4	34.3	13.4	1.5
Bibliographic, numeric, factual data bases	32.8	14.9	28.4	16.4	6.0	1.5
Theses/dissertations	53.0	28.8	12.1	4.5	0.0	1.5
Technical reports	13.4	19.4	34.3	28.4	3.0	1.5
Audio/visual materials	22.4	35.8	16.4	19.4	4.5	1.5
Foreign language technical reports	74.2	13.6	3.0	3.0	0.0	6.1
Technical translations	69.7	18.2	6.1	1.5	0.0	4.5
Patents	71.6	16.4	3.0	1.5	1.5	6.0
Industry technical reports	22.7	30.3	21.2	21.2	1.5	3.0
Drawings/specifications	9.2	13.8	30.8	27.7	15.4	3.1
Preprints or deposited manuscripts	38.8	29.9	17.9	4.5	4.5	4.5
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	6.0	13.4	34.3	34.3	10.4	1.5

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Your personal collection of information	6.0	9.0	16.4	19.4	14.9	9.0	23.9	1.5
Other students	6.0	11.9	14.9	34.3	20.9	7.5	3.0	1.5
Faculty members	1.5	7.5	10.4	14.9	26.9	19.4	17.9	1.5
Library	1.5	4.6	10.8	10.8	21.5	24.6	24.6	1.5
Librarian	23.1	12.3	26.2	20.0	7.7	7.7	1.5	1.5
Your personal contacts within industry	9.2	4.6	12.3	13.8	12.3	18.5	23.1	6.2
Your personal contacts at government laboratories	27.3	10.6	4.5	13.6	10.6	1.5	6.1	25.8

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Abstracts	16.7	12.1	4.5	19.7	22.7	15.2	3.0	6.1
Conference/meeting papers	21.2	16.7	19.7	21.2	12.1	4.5	0.0	4.5
Journal articles	7.6	6.1	13.6	16.7	13.6	27.3	15.2	0.0
Handbooks	4.6	7.7	7.7	20.0	16.9	23.1	18.5	1.5
Textbooks	0.0	1.5	4.6	6.2	27.7	32.3	26.2	1.5
Computer programs and documentation	6.1	4.5	7.6	24.2	15.2	19.7	19.7	3.0
Bibliographic, numeric, factual data bases	13.6	12.1	18.2	9.1	16.7	15.2	7.6	7.6
Theses/dissertations	26.2	23.1	10.8	15.4	12.3	4.6	0.0	7.7
Technical reports	7.6	4.5	15.2	24.2	22.7	16.7	6.1	3.0
Audio/visual materials	15.2	4.5	18.2	16.7	21.2	15.2	6.1	3.0
Foreign language technical reports	57.6	10.6	9.1	10.6	1.5	1.5	3.0	6.1
Technical translations	45.5	10.6	16.7	12.1	4.5	3.0	1.5	6.1
Patents	50.0	15.2	7.6	9.1	6.1	4.5	1.5	6.1
Industry technical reports	15.2	3.0	9.1	25.8	16.7	21.2	7.6	1.5
Drawings/specifications	3.1	3.1	4.7	18.8	17.2	26.6	23.4	3.1
Preprints or deposited manuscripts	21.5	13.8	16.9	23.1	6.2	10.8	1.5	6.2
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	3.1	3.1	10.8	12.3	20.0	36.9	13.8	0.0

27. Do you use information from the following countries in meeting your information needs?

	Yes 1 %	No 2 %	Don't Have Access 6 %
Australia	6.2	78.5	15.4
China	15.4	70.8	13.8
France	9.2	76.9	13.8
Germany	26.2	63.1	10.8
India	4.6	81.5	13.8
Japan	40.0	50.8	9.2
Netherlands	7.7	78.5	13.8
Russia	9.2	78.5	12.3
United Kingdom	30.8	58.5	10.8
United States	87.7	10.8	1.5

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1 %	2 %	3 %	4 %	Steps 5 through 7 %	Did Not Use 0 %
Used my personal store of technical information	34.4	9.4	17.2	14.1	15.7	9.4
Spoke with other students	7.7	18.5	15.4	15.4	27.7	15.4
Spoke with faculty members	18.5	20.0	13.8	12.3	17.0	18.5
Used literature resources	13.8	15.4	20.0	15.4	24.7	10.8
Spoke with a librarian	3.2	1.6	4.8	6.3	23.7	60.3
Used literature resources found in a library	15.6	20.3	10.9	12.5	25.1	15.6
Searched an electronic data base in the library	15.0	13.3	16.7	15.0	18.3	21.7

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	13.2%
Male	86.8%

30. What is your educational status?

Undergraduate	94.1%
Graduate	5.9%
Other	0.0%

31. What is your technology major?

Aero	14.7%
Construction	7.4%
Design	25.0%
Electronics	11.8%
Manufacturing	32.4%
Other	8.8%

32. What is your native language?

English	94.1%
Greek	1.5%
Spanish	4.4%

33. What is your native country?

Mexico	2.9%
USA	94.1%
Spain	1.5%
Greece	1.5%

34. Are you a citizen of the country where you are attending school?

Yes	97.1%
No	2.9%

35. How well do you read the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not read this language 6 %
English	0.0	0.0	1.5	5.9	85.3	7.4
French	14.9	6.0	7.5	1.5	0.0	70.1
German	13.6	4.5	1.5	1.5	0.0	78.8
Japanese	7.5	0.0	1.5	1.5	0.0	89.6
Russian	8.2	0.0	0.0	0.0	0.0	91.8
Spanish	43.8	18.8	12.5	6.3	18.8	0.0

36. How well do you speak the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not speak this language 6 %
English	0.0	0.0	1.5	6.0	86.6	6.0
French	16.7	7.6	3.0	1.5	0.0	71.2
German	16.9	4.6	0.0	0.0	0.0	78.5
Japanese	7.6	1.5	3.0	0.0	0.0	87.9
Russian	7.9	0.0	0.0	0.0	0.0	92.1
Spanish	68.8	6.3	6.3	0.0	18.8	0.0

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant						Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9
%	%	%	%	%	%	%	%	%
10.3	11.8	10.3	8.8	16.2	7.4	8.8	14.7	11.8

38. In what type of organization do you hope to work after graduation?

Academic	1.5%
Government	7.4%
Industry (national)	50.0%
Industry (multi-national)	38.2%
Not for profit	1.5%
Other	2.9%

39. When you were growing up, do you think your family's income was:

Much higher than that of most families in your native country	4.5%
Higher than that of most families in your native country	17.9%
About equal to the average family income in your native country	58.2%
Lower than that of most families in your native country	13.4%
Much lower than that of most families in your native country	1.5%
I cannot compare my family's income with incomes of other families	4.5%

40. Do you own a personal computer?

Yes	52.9%
No	47.1%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	13.2	27.9	39.7	13.2	4.4	1.5
Public library	6.0	23.9	38.8	25.4	6.0	0.0

42. As a technology major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading the professional literature associated with your discipline?

0 hours	4.5%
1 through 5 hours	61.1%
6 through 10 hours	26.9%
11 through 25 hours	4.5%
More than 25 hours	3.0%

43. Are you a member of a professional student (national) engineering, scientific or technical society?

Yes	67.6%
No	32.4%

APPENDIX E

TEXAS A&M UNIVERSITY

These questions ask about your career goals and aspirations.

1. To have a successful career, how important will it be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Have the opportunity to explore new ideas about technology or systems	0.0	0.0	1.9	3.8	15.1	24.5	54.7
Advance to a high-level staff technical position	5.7	3.8	9.4	18.9	26.4	17.0	18.9
Have the opportunity to work on complex technical problems	0.0	0.0	1.9	5.7	24.5	32.1	35.8
Work on projects that utilize the latest theoretical results in your specialty	0.0	1.9	3.8	13.2	22.6	28.3	30.2
Work on projects that require learning new technical knowledge	0.0	0.0	1.9	11.3	26.4	35.8	24.5
Establish a reputation outside your organization as an authority in your field	1.9	0.0	11.3	13.2	32.1	15.1	26.4
Receive patents for your ideas	7.7	15.4	17.3	19.2	17.3	1.9	21.2
Publish articles in technical journals	2.0	7.8	15.7	19.6	21.6	21.6	11.8
Communicate your ideas to others in your profession through papers delivered at professional society meetings	1.9	5.8	17.3	17.3	26.9	21.2	9.6
Be evaluated on the basis of your technical contributions	0.0	1.9	1.9	14.8	25.9	37.0	18.5
Become a manager or director in your line of work	5.6	9.3	18.5	14.8	25.9	13.0	13.0
Plan and coordinate the work of others	1.9	7.4	13.0	14.8	27.8	22.2	13.0
Advance to a policy-making position in management	13.0	9.3	13.0	14.8	22.2	16.7	11.1
Plan projects and make decisions affecting the organization	1.9	3.7	14.8	20.4	14.8	24.1	20.4
Be the technical leader of a group of less experienced professionals	0.0	5.6	1.9	20.4	24.1	22.2	25.9

These questions ask about your decision to choose a career in engineering or science.

2. How important were each of the following in making your career choice?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	NA 9 %
Your parents encouraged your area of study/major	9.3	25.9	11.1	20.4	11.1	13.0	3.7	5.6
Other family members encouraged your area of study/major	24.1	20.4	9.3	22.2	11.1	1.9	1.9	9.3
Teachers encouraged your area of study/major	13.0	18.5	18.5	14.8	20.4	3.7	3.7	7.4
You feel that a career in your major/area of study will lead to financial security	9.3	9.3	13.0	24.1	22.2	13.0	9.3	0.0
You feel that a career in your major/area of study will provide a career with many rewarding activities	3.7	0.0	0.0	1.9	14.8	29.6	50.0	0.0
Information on the career opportunities available in your major/area of study	9.3	16.7	7.4	20.4	24.1	7.4	11.1	3.7

3. When did you first decide on your area of study/major?

While still in elementary school	13.0%
While in high school (or equivalent)	57.4%
When you started college (or equivalent)	18.5%
After starting college (or equivalent)	9.3%
Other	1.9%

4. How well do your current feelings about the career opportunities in your major/area of study match with those you had when you first decided on your career path?

I am more happy about my career choice now than when I first made it	24.1%
I feel about the same now as when I first made it	37.0%
I am less happy about my career choice now than when I first made it	38.9%

These questions ask about the importance of certain skills for your professional success.

5. How important do you think it will be for you to:

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %
Effectively communicate technical information in writing	0.0	1.9	0.0	1.9	17.0	30.2	49.1
Effectively communicate technical information orally	1.9	0.0	0.0	1.9	9.4	43.4	43.4
Have a knowledge and understanding of engineering/science information resources and materials	0.0	3.8	0.0	3.8	17.0	32.1	43.4
Be able to search electronic (bibliographic) data bases	0.0	3.9	3.9	19.6	27.5	29.4	15.7
Know how to use a library that contains engineering/science information resources and materials	0.0	5.6	0.0	9.3	29.6	33.3	22.2
Effectively use computer, communication, and information technology	1.9	0.0	0.0	0.0	1.9	22.2	74.1

The next group of questions asks about course work or instruction you might have received as part of your education or academic preparation.

6. Have you received training or course work in:

	Yes 1 %	No 2 %	No Instruction Available 8 %
Technical writing/communication	74.1	24.1	1.9
Speech/oral communication	46.3	51.9	1.9
Using a library that contains engineering/science information resources and materials	66.7	31.5	1.9
Using engineering/science information resources and materials	77.8	18.5	3.7
Searching electronic (bibliographic) data bases	59.3	37.0	3.7
Using computer, communication, and information technology	88.9	9.3	1.9

7. If you received training or instruction in any of the following, was it helpful?

	Not Helpful 1 %	2 %	3 %	4 %	5 %	6 %	Very Helpful 7 %	No Training 10 %
Technical writing/communication	0.0	0.0	5.6	13.0	22.2	14.8	18.5	25.9
Speech/oral communication	0.0	0.0	5.6	5.6	14.8	13.0	7.4	53.7
Using a library that contains engineering/science information resources and materials	1.9	1.9	3.7	9.3	22.2	14.8	9.3	37.0
Using engineering/science information resources and materials	1.9	1.9	3.7	11.1	20.4	22.2	14.8	24.1
Searching electronic (bibliographic) data bases	0.0	3.7	3.7	9.3	16.7	16.7	9.3	40.7
Using computer, communication, and information technology	0.0	0.0	1.9	5.6	11.1	20.4	51.9	9.3

These next questions ask about your preparation of written technical communication as part of your education or academic preparation.

8. What percentage of your written technical communication involves collaborative writing?

0 percent	16.7%
1 through 25 percent	52.2%
26 through 50 percent	16.7%
51 through 75 percent	4.2%
76 through 99 percent	6.3%
100 percent	4.2%

9. If you do write as a member of a group, what percentage of your written technical communication is required to be collaborative?

0 percent	8.3%
1 through 25 percent	58.3%
26 through 50 percent	19.5%
51 through 75 percent	2.8%
76 through 99 percent	5.6%
100 percent	5.6%

10. In general, do you find writing as part of a group more or less productive than writing alone?

Less productive than writing alone	47.5%
About as productive as writing alone	12.5%
More productive than writing alone	40.0%

11. Do you use a computer to prepare written technical communication?

Never	0.0%
Sometimes	0.0%
Frequently	13.0%
Always	87.0%

13. To what extent does lack of knowledge/skill about each of the following communication principles impede your ability to produce written technical communication?

	Does not Impede 1 %	2 %	3 %	4 %	5 %	6 %	Greatly Impedes 7 %
Defining the purpose of the communication	32.7	10.2	6.1	20.4	8.2	12.2	10.2
Assessing the needs of the reader	12.2	22.4	14.3	18.4	20.4	4.1	8.2
Preparing/presenting information in an organized manner	24.0	22.0	16.0	4.0	12.0	18.0	4.0
Developing paragraphs (introductions, transitions, and conclusions)	30.6	18.4	6.1	14.3	10.2	18.4	2.0
Writing grammatically correct sentences	36.7	16.3	16.3	6.1	12.2	12.2	0.0
Notetaking and quoting	29.2	18.8	10.4	27.1	12.5	2.1	0.0
Editing and revising	28.6	14.3	22.4	12.2	14.3	6.1	2.0

These questions ask about your use of electronic/information technologies.

14. Describe your use of the following electronic/information technologies for communicating technical information.

	I already use it 1 %	I don't use it, but may in the future 2 %	I don't use it and doubt if I will 3 %
Audio tapes and cassettes	5.7	26.4	67.9
Motion picture film	7.5	35.8	56.6
Video tape	28.3	50.9	20.8
Desktop/electronic publishing	77.8	20.4	1.9
Computer cassette/cartridge tapes	39.6	34.0	26.4
Electronic mail	67.9	30.2	1.9
Electronic bulletin boards	32.1	56.6	11.3
FAX or TELEX	54.7	39.6	5.7
Electronic data bases	49.1	49.1	1.9
Video conferencing	0.0	81.1	18.9
Computer conferencing	5.7	77.4	17.0
Micrographics & microforms	37.7	49.1	13.2

15. Do you ever use electronic networks?

Yes, I personally use them	74.1%
Yes, I use them but through an intermediary	7.4%
No	9.3%
No, because I do not have access	1.9%
No, but I may use them in the future	7.4%

16. Do you use electronic networks for the following purposes?

	Yes 1 %	No 2 %
To connect to geographically distant sites	70.5	29.5
For electronic mail	90.9	9.1
For electronic bulletin boards or conferences	43.2	56.8
For electronic file transfer	88.6	11.4
To log into computers for such things as computational analysis or to use design tools	77.3	22.7
To control equipment such as laboratory instruments or machine tools	9.1	90.9
To access/search the library's catalogue	90.9	9.1
To order documents from the library	6.8	93.2
To search electronic (bibliographic) data bases	63.6	36.4
For information search and data retrieval	54.5	45.5
To prepare scientific and technical papers with colleagues at geographically distant sites	4.5	95.5

17. Do you exchange electronic messages or files with:

	Yes 1 %	No 2 %
Members of your academic classes	72.7	27.3
Other people in your academic community at the same geographic site who are not in your academic classes	52.3	47.7
Other people in your academic community at a different geographic site who are not in your academic classes	56.8	43.2
People outside your academic community	65.9	34.1

These questions ask about your use of libraries and library services as part of your education.

18. During this current school term, about how many times have you used a library to meet your engineering/science information needs?

0 times	13.2%
1 through 25 times	73.6%
26 through 50 times	11.3%
51 through 75 times	1.9%
More than 75 times	0.0%

19. During the current school term, how effective was the information obtained from the library for meeting your engineering/science information needs?

Very Ineffective						Very Effective
1	2	3	4	5	6	7
%	%	%	%	%	%	%
4.3	2.1	19.1	23.4	27.7	14.9	8.5

20. Which of the following statements best describes your reasons for not using a library during this current school term?

	Yes 1 %	No 2 %
I had no information needs	57.1	42.9
My information needs were more easily met some other way	85.7	14.3
Tried the library once or twice before but I couldn't find the information I needed	14.3	85.7
The library is physically too far away	0.0	100.0
The library staff is not cooperative or helpful	0.0	100.0
The library staff does not understand my information needs	16.7	83.3
The library did not have the information I need	16.7	83.3
I have my own personal library and do not need another library	50.0	50.0
The library is too slow in getting the information I need	0.0	100.0
We have to pay to use the library	0.0	100.0
We are discouraged from using the library	0.0	100.0

21. As part of your academic preparation, have you received or participated in the following library activities?

	Yes 1 %	No 2 %	Not Available 6 %
Library tour	35.8	64.2	0.0
Library presentation as part of academic orientation	16.0	82.0	2.0
Library orientation as part of an engineering/ science course	5.8	86.5	7.7
Library skill/use course (bibliographic instruction)	21.2	76.9	1.9
Library skill/use course in engineering/science information resources and materials	13.5	80.8	5.8
Library instruction for end-user searching of electronic (bibliographic) data bases	34.6	65.4	0.0

22. Which one of the following best characterizes your use of electronic data bases?

I do all searches myself	51.9%
I do most searches myself	31.5%
I do half by myself and half through a librarian	1.9%
I do most searches through a librarian	5.6%
I do all searches through a librarian	0.0%
I do not use electronic data bases	7.4%
I do not have access to electronic data bases	1.9%

These questions ask about the use and importance of information to engineering/science students.

23. How often during this current school term have you used the following information sources to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Your personal collection of information	0.0	3.7	1.9	63.0	31.5	0.0
Other students	1.9	3.7	40.7	51.9	1.9	0.0
Faculty members	1.9	18.5	33.3	42.6	3.7	0.0
Library	9.3	35.2	31.5	20.4	3.7	0.0
Librarian	51.9	35.2	11.1	1.9	0.0	0.0
Your personal contacts within industry	50.0	18.5	18.5	5.6	0.0	7.4
Your personal contacts at government laboratories	53.7	5.6	13.0	7.4	0.0	20.4

24. How often during this current school term have you used the following information products to meet your engineering/science information needs?

	Never 1 %	Seldom 2 %	Sometimes 3 %	Frequently 4 %	Always 5 %	Not Available 6 %
Abstracts	39.6	24.5	22.6	9.4	3.8	0.0
Conference/meeting papers	25.9	14.8	27.8	27.8	3.7	0.0
Journal articles	11.1	11.1	27.8	44.4	5.6	0.0
Handbooks	18.5	25.9	22.2	27.8	3.7	1.9
Textbooks	0.0	0.0	7.4	57.4	35.2	0.0
Computer programs & documentation	3.7	11.1	27.8	48.1	9.3	0.0
Bibliographic, numeric, factual data bases	22.2	46.3	24.1	5.6	1.9	0.0
Theses/dissertations	33.3	31.5	22.2	11.1	1.9	0.0
Technical reports	7.4	13.0	53.7	22.2	3.7	0.0
Audio/visual materials	64.8	25.9	5.6	3.7	0.0	0.0
Foreign language technical reports	79.6	16.7	1.9	1.9	0.0	0.0
Technical translations	63.0	29.6	7.4	0.0	0.0	0.0
Patents	88.9	9.3	1.9	0.0	0.0	0.0
Industry technical reports	50.0	29.6	14.8	5.6	0.0	0.0
Drawings/specifications	56.6	17.0	18.9	7.5	0.0	0.0
Preprints or deposited manuscripts	70.4	20.4	7.4	1.9	0.0	0.0
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	40.7	27.8	24.1	7.4	0.0	0.0

25. How important are the following information sources in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Your personal collection of information	0.0	1.9	3.7	5.6	9.3	29.6	50.0	0.0
Other students	1.9	1.9	7.4	27.8	35.2	24.1	1.9	0.0
Faculty members	0.0	1.9	13.0	20.4	24.1	18.5	22.2	0.0
Library	3.7	9.3	18.5	25.9	20.4	14.8	7.4	0.0
Librarian	38.9	37.0	11.1	7.4	3.7	0.0	1.9	0.0
Your personal contacts within industry	38.9	16.7	14.8	9.3	11.1	1.9	0.0	7.4
Your personal contacts at government laboratories	44.4	7.4	5.6	7.4	11.1	1.9	0.0	22.2

26. How important are the following information products in meeting your engineering/science information needs?

	Very Unimportant 1 %	2 %	3 %	4 %	5 %	6 %	Very Important 7 %	Not Available 8 %
Abstracts	16.7	16.7	16.7	22.2	9.3	5.6	11.1	1.9
Conference/meeting papers	7.4	16.7	11.1	14.8	20.4	14.8	14.8	0.0
Journal articles	3.7	9.3	7.4	14.8	24.1	16.7	24.1	0.0
Handbooks	11.3	15.1	11.3	22.6	17.0	11.3	11.3	0.0
Textbooks	0.0	0.0	1.9	3.7	16.7	33.3	44.4	0.0
Computer programs and documentation	7.4	3.7	3.7	20.4	16.7	31.5	16.7	0.0
Bibliographic, numeric, factual data bases	18.5	9.3	25.9	20.4	18.5	7.4	0.0	0.0
Theses/dissertations	14.8	18.5	22.2	16.7	16.7	7.4	3.7	0.0
Technical reports	3.7	7.4	14.8	24.1	24.1	18.5	7.4	0.0
Audio/visual materials	57.4	14.8	9.3	13.0	1.9	1.9	0.0	1.9
Foreign language technical reports	74.1	14.8	5.6	5.6	0.0	0.0	0.0	0.0
Technical translations	61.1	16.7	14.8	5.6	0.0	1.9	0.0	0.0
Patents	70.4	22.2	7.4	0.0	0.0	0.0	0.0	0.0
Industry technical reports	29.6	14.8	18.5	18.5	13.0	1.9	1.9	1.9
Drawings/specifications	50.0	13.0	13.0	13.0	3.7	1.9	3.7	1.9
Preprints or deposited manuscripts	63.0	11.1	9.3	7.4	3.7	3.7	0.0	1.9
Informal information products (e.g., vendor/supply catalogs, company literature, trade journals/magazines)	38.9	16.7	16.7	14.8	7.4	3.7	1.9	0.0

27. Do you use the following technical reports in meeting your engineering/science information needs?

	Yes 1 %	No 2 %	Don't Have Access 6 %
AGARD reports	20.4	72.2	7.4
British ARC and RAE reports	16.7	70.4	13.0
Dutch NLR reports	0.0	83.3	16.7
ESA reports	9.3	75.9	14.8
Indian NAL reports	1.9	81.5	16.7
French ONERA reports	5.7	79.2	15.1
German DFVLR, DLR, and MBB reports	13.0	72.2	14.8
Japanese NAL reports	0.0	83.3	16.7
Russian TsAGI reports	1.9	79.6	18.5
U.S. NASA reports	87.0	9.3	3.7

28. Think of the most technically challenging assignment you have worked on this current school term. What steps did you follow to obtain the information you needed to complete this assignment?

	Step 1 %	2 %	3 %	4 %	Steps 5 through 7 %	Did Not Use 0 %
Used my personal store of technical information	64.2	13.2	7.5	7.5	7.6	0.0
Spoke with other students	3.8	28.3	15.1	15.1	26.4	11.3
Spoke with faculty members	18.9	17.0	26.4	15.1	17.0	5.7
Used literature resources	5.7	24.5	22.6	22.6	9.4	15.1
Spoke with a librarian	2.0	0.0	4.0	4.0	14.0	76.0
Used literature resources found in a library	9.6	7.7	21.2	13.5	25.0	23.1
Searched an electronic data base in the library	2.0	12.0	6.0	12.0	16.0	52.0

These questions will be used to determine whether students with different backgrounds and from different countries have different technical communication practices.

29. What is your gender?

Female	13.0%
Male	87.0%

30. What is your educational status?

Undergraduate	46.3%
Graduate	51.9%
Other	1.9%

31.. Is your education primarily as:

An engineer	98.1%
A scientist	1.9%

32. What is your native language?

English	87.0%
German	1.9%
Chinese	1.9%
Hindi	1.9%
Other	7.4%

33. What is your native country?

Canada	1.9%
Germany	1.9%
Hong Kong	1.9%
India	5.6%
USA	85.2%
Other	3.7%

34. Are you a citizen of the country where you are attending school?

Yes	90.7%
No	9.3%

35. How well do you read the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not read this language 6 %
English	0.0	0.0	0.0	1.9	96.3	1.9
French	0.0	11.1	0.0	0.0	1.9	87.0
German	9.3	3.7	3.7	0.0	3.7	79.6
Japanese	0.0	0.0	0.0	0.0	0.0	100.0
Russian	4.1	0.0	0.0	0.0	2.0	93.9
Spanish	37.5	12.5	37.5	0.0	12.5	0.0
Other	75.0	0.0	0.0	0.0	25.0	0.0

36. How well do you speak the following languages?

	Passably 1 %	2 %	3 %	4 %	Fluently 5 %	Do not speak this language 6 %
English	0.0	0.0	0.0	3.8	94.3	1.9
French	3.7	5.6	1.9	0.0	3.7	85.2
German	5.6	1.9	1.9	0.0	3.7	87.0
Japanese	1.9	0.0	0.0	0.0	0.0	98.1
Russian	3.9	0.0	0.0	0.0	2.0	94.1
Spanish	16.7	50.0	16.7	0.0	16.7	0.0

37. In terms of your career goals and aspirations, how important will it be for you to be bilingual?

Very Unimportant						Very Important	Am Not Bilingual	Don't Know
1	2	3	4	5	6	7	8	9
%	%	%	%	%	%	%	%	%
18.5	7.4	11.1	1.9	11.1	3.7	11.1	24.1	11.1

38. In what type of organization do you hope to work after graduation?

Academic	13.0%
Government	20.4%
Industry (national)	42.6%
Industry (multi-national)	24.1%
Not for profit	1.9%
Other	14.8%

39. When you were growing up, do you think your family's income was:

Much higher than that of most families in your native country	0.0%
Higher than that of most families in your native country	25.9%
About equal to the average family income in your native country	59.3%
Lower than that of most families in your native country	11.1%
Much lower than that of most families in your native country	1.9%
I cannot compare my family's income with incomes of other families	1.9%

40. Do you own a personal computer?

Yes	57.4%
No	42.6%

41. As a high school student, how often did you use your:

	Never	Seldom	Sometimes	Frequently	Always	Not Available
	1	2	3	4	5	6
	%	%	%	%	%	%
High school library	11.1	20.4	42.6	18.5	3.7	3.7
Public library	11.1	31.5	37.0	13.0	1.9	5.6

42. As an engineering or physics major, about how many hours a week (exclusive of classroom and course assignments) do you spend reading the professional literature associated with your discipline?

0 hours	7.5%
1 through 5 hours	83.0%
6 through 10 hours	5.7%
11 through 25 hours	3.8%
More than 25 hours	0.0%

43. Are you a member of a professional student (national) engineering, scientific or technical society?

Yes	75.9%
No	24.1%

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13. ABSTRACT *(Maximum 200 words)*
This report describes similarities and differences between undergraduate and graduate engineering science students in the context of two general aspects of the educational experience. First, we explore the extent to which students differ regarding the factors that lead to the choice of becoming an engineer or a scientist, current satisfaction with that choice, and career-related goals and objectives. Second, we look at the technical communication practices, habits, and training of engineers and science (Physics) students. The reported data were obtained from a survey of students enrolled in the College of Engineering at the University of Illinois at Urbana-Champaign, Bowling Green State University, and Texas A&M University. The survey was undertaken as part of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* Data are reported for the following categories: student demographics; skill importance, skill training, and skill helpfulness; collaborative writing; computer and information technology use and importance, use of electronic networks; use and importance of libraries and library services; use and importance of information sources and products; use of foreign language technical reports; and foreign language (reading and speaking) skills.

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